

*A Bibliography of*

**ORGANIC ACIDS  
IN HIGHER PLANTS**

**Agricultural Handbook No. 164**

**Agricultural Research Service**

**UNITED STATES DEPARTMENT OF AGRICULTURE**

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# A BIBLIOGRAPHY OF ORGANIC ACIDS IN HIGHER PLANTS<sup>1</sup>

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Scientific interest in the organic acids of higher plants has prompted a search of the literature and tabulation of these acids and their occurrence.

Nonvolatile, non-nitrogen-containing, carboxylic acids whose structure is generally accepted (44, 267, 483)<sup>2</sup> are included. Fatty acids, long-chain polymers—such as pectins—and compounds which contain a sugar group as part of the molecule are excluded. Thus, carboxylic sapogenins are included but saponins are not. The acids reported are those that are found in the free state or as salts, not as esters.

Plants are listed by family and by genus and species. The family names are those given by Willis (789), and, when possible, the names of the genus and species follow this system. Where the name disagrees with that in established usage by the Department of Agriculture the latter name is given in parentheses following the original name. Where the name is apparently misspelled, doubtful, or not known by the Department a query(?) has been inserted following the original name. Only spermatophyta are included.

Titles of articles and books published in other languages have been translated into English. In those cases in which the report could not be verified by consulting the original paper or an abstract, a secondary reference is substituted.

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<sup>1</sup> This review covers all publications through 1954 and a limited number published in 1955 and 1956.

<sup>2</sup> Italic numbers in parentheses refer to Literature Cited, p. 51.

# OCCURRENCE OF ORGANIC ACIDS IN HIGHER PLANTS

Family	Genus and species	Source	Reference
<b>Abietic Acid</b>			
Pinaceae			
	{	Colophony-----	(37, 113, 162, 169)
	<i>Pinus abies</i> ( <i>Picea abies</i> ) -	Resin-----	(48, 419)
	<i>P. larix</i> ( <i>Larix decidua</i> )--	-----	(419)
	<i>P. palustris</i> -----	Resin-----	(35, 258, 339)
<b>Aconitic Acid</b>			
$\begin{array}{c} \text{COOH} \\   \\ \text{C}=\text{CH COOH} \\   \\ \text{CH}_2\text{COOH} \end{array}$			
Chenopodiaceae	<i>Beta vulgaris</i> -----	{Juice-----	(392, 395)
Compositae	{ <i>Achillea millefolium</i> ----- <i>Helianthus annuus</i> -----	{Unripe beet----- -----	(705) (286) (68)
	<i>Avena sativa</i> -----	-----	(474)
	<i>Hordeum vulgare</i> -----	{Etiolated shoot. Seedling-----	(168)
Gramineae	{ <i>Saccharum officinarum</i> ----- <i>Secale cereale</i> -----	{Juice----- {Seedling-----	(314, 474) (36; 50; 411; 603; 604; 605; 694; 699; 703; 704, ref. 162; 784; 811; 817) (474) (668)

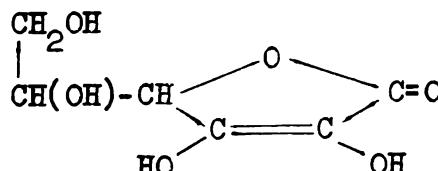
Family	Genus and species	Source	Reference
<b>Aconitic Acid—Continued</b>			
Gramineae-----	<i>Sorghum vulgare</i> -----	{ Scale from evaporation pans. Juice-----	(414, 744) (507)
	<i>Triticum</i> sp-----	{ Sprout----- Seedling-----	(473) (667)
Leguminosae-----	<i>T. sativum</i> ( <i>T. aestivum</i> )-----	Seedling-----	(668)
	<i>Zea mays</i> -----	Sprouting seed-----	(668) (58)
Ranunculaceae---	<i>Phaseolus coccineus</i> -----	-----	(58)
	<i>Aconitum</i> spp-----	-----	(54; 58; 108; 160, p. 567, ref. 3; 497)
	<i>A. columbianum</i> -----	-----	(49)
	<i>A. heterophyllum</i> -----	{ Root-----	(322) (769)
	<i>A. napellus</i> -----	-----	(50)
	<i>A. septentrionale</i> -----	Tuber and root-----	(315)
	<i>A. vernalis</i> ( <i>Adonis vernalis</i> )-----	{ Leaf-----	(497) (388)
	<i>Delphinium barbeyi</i> -----	-----	(49)
	<i>D. bicolor</i> -----	-----	(49)
	<i>D. consolida</i> -----	Leaf sap-----	(781)
	<i>D. cucullatum</i> -----	-----	(49)
	<i>D. geyeri</i> -----	-----	(49)
	<i>D. glaucescens</i> -----	-----	(49)
	<i>D. nelsonii</i> -----	-----	(49)
Solanaceae-----	<i>Solanum lycopersicum</i> -----	{ Fruit-----	(109)
	( <i>Lycopersicon esculentum</i> ).-----	Root, leaf, and ripe fruit.	(116)
Umbelliferae-----	<i>Angelica archangelica</i> -----	Root-----	(690)

## **Adipic Acid**



**Chenopodiaceae** -- *Beta vulgaris*----- (396, 742)

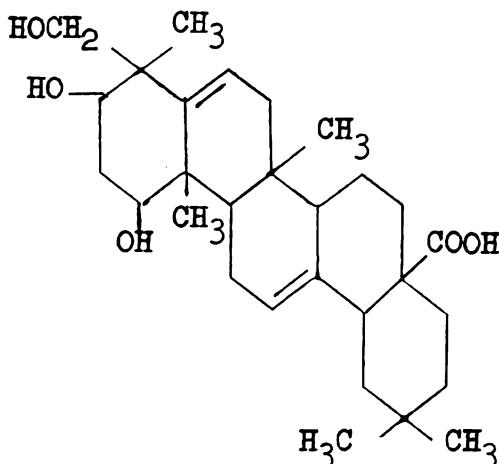
## **Ascorbic Acid**



Since its structure was elucidated by Svirbely and Szent-Györgyi in 1932 (691, 692), ascorbic acid has been reported in almost every plant in which its presence has been investigated.

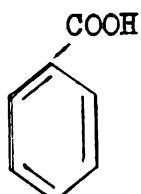
Family	Genus and species	Source	Reference
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### Bassic Acid



Sapotaceae-----	$\left\{ \begin{array}{l} Acras sapota \\ Bassia butyracea \\ \quad (Madhuca butyracea). \\ B. latifolia (M. latifolia) \\ B. longifolia (M. longi- \\ \quad folia). \\ B. parkii \\ Dumoria heckelii \\ Mimusops djave (Bail- \\ \quad lonella toxisperma). \\ M. elengi \\ M. hexandra \\ Payena lucida \end{array} \right.$	$\begin{array}{ll} \text{Seed} & \dots \\ \text{do} & \dots \end{array}$	$\begin{array}{ll} (276) \\ (276, 277) \\ (276, 277) \\ (276) \\ (276, 277) \\ (276) \\ (276) \\ (276) \\ (276) \end{array}$
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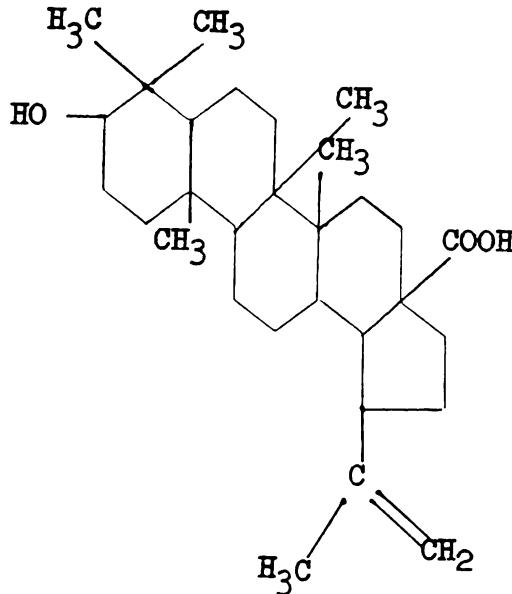
### Benzoic Acid



Compositae-----	<i>Dahlia</i> sp-----		(511)
Droseraceae-----	<i>Drosera rotundifolia</i> -----		(796)
Empetraceae-----	<i>Empetrum nigrum</i> -----	Leaf-----	(306)
Ericaceae-----	$\left\{ \begin{array}{l} Vaccinium macrocarpum \\ V. oxyccocos \\ V. vitis-idaea \end{array} \right.$	$\begin{array}{ll} \text{Berry} & \dots \\ \text{do} & \dots \\ \text{do} & \dots \end{array}$	$\begin{array}{ll} (239, 434, 467) \\ (239, 415, 477, \\ \quad 599) \end{array}$
Gramineae-----	<i>Bambusa arundinacea</i> ---	Young shoot---	(51, 239, 328, 382, 403, 477, (218)

Family	Genus and species	Source	Reference
<b>Benzoic Acid—Continued</b>			
Leguminosae-----	{ <i>Daviesia latifolia</i> -----	Leaf and stem-----	(555)
	<i>Myroxylon pereirae</i> -----	Balsam-----	(361)
Lentibulariaceae-----	<i>M. toluiferum</i> -----	do-----	(110, 146)
	<i>Pinguicula vulgaris</i> -----	Leaf-----	(405)
Lilaceae-----	{ <i>Dracera draco</i> -----	Resin-----	(715a)
	<i>Gloriosa superba</i> -----	Tuber-----	(123)
Magnoliaceae-----	<i>Illicium anisatum</i> -----	Fruit and seed-----	(498)
Myrtaceae-----	<i>Psidium</i> spp-----	-----	(515)
Papaveraceae-----	<i>Papaver somniferum</i> -----	-----	(635)
Pinaceae-----	<i>Agathis australis</i> -----	-----	(457)
Rosaceae-----	<i>Prunus serotina</i> -----	{ Bark-----	(550)
		Leaf-----	(551)
Rubiaceae-----	<i>Coffea</i> sp-----	-----	(410, 516)
Rutaceae-----	<i>Casimiroa edulis</i> -----	Seed-----	(549)
Serophulariaceae-----	<i>Digitalis purpurea</i> -----	-----	(331)
Styracaceae-----	{ <i>Styraza</i> sp-----	-----	(372; 718, p.
	<i>S. benzoin</i> -----	Resin-----	507, ftn. 4.) (715a)

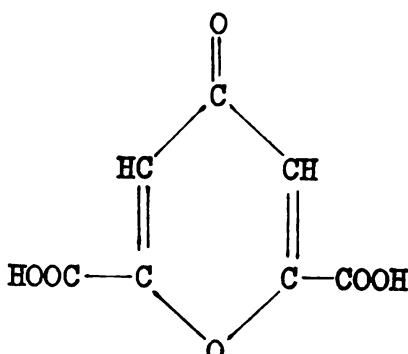
### Betulinic Acid



Apocynaceae-----	<i>Alyxia buxifolia</i> -----	Bark-----	(21)
Cornaceae-----	<i>Cornus florida</i> -----	-----	(606)
Gentianaceae-----	<i>Menyanthes trifoliata</i> -----	Rhizome-----	(671)
Loranthaceae-----	<i>Nuytsia floribunda</i> -----	Leaves, stems, and bark.	(21)
Myrtaceae-----	{ <i>Melaleuca</i> (6 spp.) -----	Bark-----	(21)
	<i>Syncarpia laurifolia</i> -----	do-----	(579)
Platanaceae-----	<i>Platanus acerifolia</i> -----	do-----	(100)
Punicaceae-----	<i>Punica granatum</i> -----	Leaves and bark-----	(98)
Rhamnaceae-----	<i>Ziziphus vulgaris</i> -----	Seeds and bark-----	(333)

Family	Genus and species	Source	Reference
<b>Caffeic Acid</b>			
$\text{CH}=\text{CHCOOH}$			
Aquifoliaceae	<i>Ilex aquifolium</i>	Leaf	(678)
	<i>I. paraguarensis</i>	do	(678)
Compositae	<i>Anthemis nobilis</i>	Flower	(547)
	<i>Taraxacum officinale</i>	Root	(546)
Labiatae	<i>Melissa</i> sp.	Leaf	(272)
Pinaceae	<i>Larix europaea</i> ( <i>L. decidua</i> )	Resin	(37)
Ranunculaceae	<i>Aconitum septentrionale</i>	Flowering branch.	(315)
	<i>Clematis vitalba</i>		(730)
Rosaceae	<i>Crataegus oxyacantha</i>	Leaf, fruit, and flower.	(187)
Rubiaceae	<i>Cinchona cuprea</i>	Bark	(349)
	<i>Coffea</i> spp.	{ Bean Leaf	(187) (678)
Scrophulariaceae	<i>Digitalis purpurea</i>		(88, 331)
	<i>Scrophularia nodosa</i>	Root	(317)
Solanaceae	<i>Solanum tuberosum</i>		(323)
Umbelliferae	<i>Angelica archangelica</i>		(690)
	<i>Conium maculatum</i>		(288)

### Chelidonic Acid



Amarylidaceae	<i>Agave</i> sp.	Leaf	(684)
	<i>A. falcata</i>	Anther and perianth.	(581) (582)
	<i>Amaryllis crispa</i> ( <i>Hessea crispa</i> )	Leaf, perianth, and anther.	(582)

Family	Genus and species	Source	Reference
<b>Chelidonic Acia—Continued</b>			
	<i>Androstemma junceum</i> ( <i>Conostylis androstemma</i> ). <i>Anigozanthos humilis</i> . <i>A. preissii</i> . <i>Anoiganthus breviflorus</i> . <i>Blancoa canescens</i> . <i>Brunsvigia angustifolia</i> . <i>B. josephinea</i> ( <i>B. gigantea</i> ). <i>B. uitenhagensis</i> . <i>Buphane ciliaris</i> . <i>Carpolyza spiralis</i> . <i>Conostylis</i> (12 spp.). <i>Crinum capense</i> ( <i>C. longifolium</i> ). <i>C. kirkii</i> . <i>C. purpurascens</i> . <i>Cummingia tenella</i> ( <i>Conanthera campanulata</i> ). <i>Galanthus nivalis</i> . <i>G. plicatus</i> . <i>Hessea maximiliani</i> . <i>Hippeastrum mandonii</i> . <i>Hypoxis juncea</i> . <i>H. minuta</i> . <i>H. probata</i> . <i>H. serrata</i> . <i>H. villosa</i> . <i>Ixiolirion montanum</i> . <i>Lanaria plumosa</i> . <i>Leucojum</i> (5 spp.). <i>Lophiola americana</i> . <i>Lycoris aurea</i> . <i>Narcissus</i> (14 spp.). <i>Panoratium canariense</i> . <i>Sternbergia colchiciflora</i> . <i>S. lutea</i> . <i>Tribonanthes uniflora</i> . <i>Zephyranthes rosea</i> . <i>Berberis vulgaris</i> .	Leaf, perianth, and anther. Leaf----- Anther----- Pericarp----- Leaf and perianth. Leaf and flower. Pericarp, leaf, perianth, and anther. Flower----- Leaf, perianth, and anther. Leaf, perianth, and bulb. ----- Leaf, perianth, and pedicel. ----- Leaf, perianth, and anther. Perianth----- Leaf, pedicel, anther, and perianth. Leaf, perianth, pedicel, and bulb. Flower----- Leaf, perianth, anther, and pedicel. Flower----- Flower and leaf Perianth----- Perianth, leaf, and anther. Leaf, and perianth. Perianth, leaf, and flower. Leaf and perianth. ----- Leaf and flower. Perianth, anther, pedicel, and pericarp. ----- Leaf and anther. Leaf, perianth, anther, and seed. Leaf, perianth, and anther. Perianth----- Perianth, leaf, and anther.	(582) (582)
Berberidaceae			(370)

Family	Genus and species	Source	Reference
<b>Chelidonic Acid—Continued</b>			
Campanulaceae	<i>Centropogon</i> (6 spp.)-----	-----	(582)
	<i>Downingia pulchella</i> -----	-----	(582)
	<i>Isotoma</i> (5 spp.)-----	-----	(582)
	<i>Laurentia</i> (4 spp.)-----	-----	(582)
	<i>Lobelia</i> (25 spp.)-----	-----	(582)
	<i>L. cardinalis</i> -----	-----	(370)
	<i>L. inflata</i> -----	{Fruit-----	(370) (581)
Cannaceae	<i>L. syphilitica</i> -----	-----	(370)
	<i>Siphocampylus</i> (9 spp.)-----	-----	(582)
	<i>Canna</i> spp.-----	Root-----	(581)
Dioscoreaceae	<i>Discorea bolcanica</i> -----	Leaf, flower, and pericarp.	(582)
	<i>D. deltoidea</i> -----	Leaf and flower.	(582)
	<i>D. humifusa</i> -----	Seed and pericarp.	(582)
	<i>Dilatris corymbosa</i> -----	Flower and leaf.	(582)
Haemodoraceae	<i>Lechenolia tinctoria</i> -----	do-----	(582)
	<i>Wachendorfia paniculata</i> -----	Flower, leaf, and pericarp.	(582)
	<i>W. thyrsiflora</i> -----	Anther-----	(582)
Hippocastanaceae	<i>Aesculus flava</i> -----	Perianth and leaf.	(582)
	<i>A. hippocastanum</i> -----	-----	(581)
	<i>Acanthocarpus preissii</i> -----	Pericarp and leaf.	(582)
	<i>Allium cirrhosum</i> -----	Leaf-----	(582)
	<i>A. flavescens</i> -----	do-----	(582)
	<i>A. obliquum</i> -----	do-----	(582)
	<i>A. tenuissimum</i> -----	Leaf and flower.	(582)
	<i>Aloe minima</i> -----	Leaf-----	(582)
	<i>Androcymbium</i> (3 spp.)-----	-----	(582)
	<i>Anguillaria dioica</i> -----	do-----	(582)
Liliaceae	<i>A. tenella</i> -----	do-----	(582)
	<i>Anticlea sibiricus</i> ( <i>Zigadenus sibiricus</i> ).-----	Leaf, bulb, and filament.	(582)
	<i>A. sparagus</i> (11 spp.)-----	-----	(582)
	<i>A. officinalis</i> -----	-----	(580)
	<i>A. phodelus clavatus</i> -----	-----	(582)
	<i>A. damascena</i> -----	-----	(582)
	<i>Bellavalia dubia</i> ( <i>Hycinthus dubius</i> ).-----	Flower-----	(582)
	<i>Boemetra columellaris</i> (?)-----	Filament, leaf, and perianth.	(582)
	<i>Borya septentrionalis</i> -----	Leaf-----	(582)
	<i>Brodiaea</i> (3 spp.)-----	-----	(582)
	<i>Bulbine alooides</i> -----	Flower-----	(582)
	<i>Bulbocodium ruthenicum</i> -----	Leaf-----	(582)
	<i>B. versicciar</i> -----	do-----	(582)
	<i>Chlorophytum bowkeri</i> -----	Flower-----	(582)
	<i>C. parviflorum</i> -----	Pedicel-----	(582)
	<i>Colchicum</i> (12 spp.)-----	-----	(582)
	<i>C. autumnale</i> -----	-----	(370)
	<i>Convallaria majalis</i> -----	{Leaf, anther, and perianth.	(370) (582)
	<i>Cordyline banksii</i> -----	Flower-----	(582)
	<i>C. pumilio</i> -----	Leaf-----	(582)
	<i>Dasyurion graminifolium</i> .-----	Flower-----	(582)

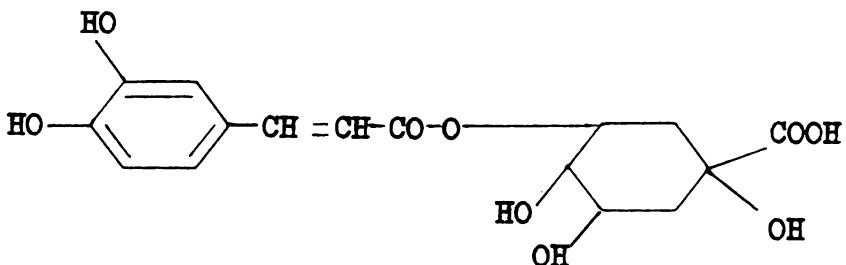
Family	Genus and species	Source	Reference
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### Chelidonic Acid—Continued

Liliaceae-----	<i>Dasypogon bromeliifoius</i> -----	Flower-----	(582)
	<i>Dichopogon humilis</i> -----	do-----	(582)
	<i>Dracaena angustifolia</i> -----	Leaf-----	(582)
	<i>D. elliptica</i> -----	Flower-----	(582)
	<i>Eremurus himalaicus</i> -----	Leaf-----	(582)
	<i>Gloriosa superba</i> -----	-----	(370, 399)
	<i>Hookera hyacintha</i> -----	Flower-----	(582)
	<i>H. minor</i> -----	do-----	(582)
	<i>Hyacinthus leucophaeus</i> -----	do-----	(582)
	<i>Iphigenia diuterik</i> (?)-----	Leaf-----	(582)
	<i>I. indica</i> -----	do-----	(582)
	<i>Johnsonia lupulina</i> -----	do-----	(582)
	<i>Kniphofia</i> (4 spp.)-----	-----	(582)
	<i>Lachenalia montigena</i> -----	Leaf-----	(582)
	<i>L. picta</i> -----	Leaf and flower.	(582)
	<i>Liriope graminifolia</i> -----	Leaf-----	(582)
	<i>Melonanthium tenue</i> -----	Leaf, perianth, and seed.	(582)
	<i>M. virginicum</i> ( <i>M. comosum</i> )-----	Leaf and flower.	(582)
	<i>Merendera</i> (5 spp.)-----	-----	(582)
	<i>Muscaris botryoides</i> -----	Flower-----	(582)
	<i>M. calandriniatum</i> -----	Flower and leaf	(582)
	<i>Narthecium scardicum</i> -----	Flower-----	(582)
	<i>Ophiopogon bockianus</i> -----	Leaf-----	(582)
	<i>O. japonicus</i> -----	do-----	(582)
	<i>Ornithogalum arabicum</i> -----	Anther-----	(582)
	<i>O. fimbriatum</i> -----	Leaf and perianth.	(582)
	<i>O. narbonense</i> -----	Flower-----	(582)
	<i>O. oligophyllum</i> -----	Pedicel-----	(582)
	<i>Ornithoglossum glaucum</i> -----	Leaf and flower.	(582)
	<i>Paradisea liliastrum</i> -----	Leaf-----	(582)
	<i>Paris bockiana</i> -----	Leaf and perianth.	(582)
	<i>Polygonatum</i> (4 spp.)-----	do-----	(582)
	<i>Reineckea carnea</i> -----	Leaf and pedicel.	(582)
	<i>Rhipogonum album</i> -----	Pedicel-----	(582)
	<i>R. scandens</i> -----	Leaf and pedicel.	(582)
	<i>Ruscus hypoglossum</i> -----	Flower-----	(582)
	<i>Sabadilla officinarum</i> ( <i>Schoenocaulon officinale</i> ).-----	-----	(684)
	<i>Sandersonia aurantiaca</i> -----	Leaf and perianth.	(582)
	<i>Schoenocaulon officinale</i> -----	-----	(370)
	<i>Scilla obtusifolia</i> -----	Leaf and flower.	(582)
	<i>S. pratensis</i> -----	Flower-----	(582)
	<i>S. verna</i> -----	Leaf-----	(582)
	<i>Smilax</i> (6 spp.)-----	-----	(582)
	<i>Sugericaria orientalis</i> ( <i>Heloniopsis orientalis</i> ).-----	Leaf, flower, and anther.	(582)
	<i>Tofieldia</i> (4 spp.)-----	-----	(582)
	<i>Trichopetalum stellatum</i> ( <i>Bottomea thysantoides</i> ).-----	Flower-----	(582)
	<i>Trillium</i> (9 spp.)-----	-----	(582)
	<i>Tupistra viridiflora</i> -----	Leaf-----	(582)
	<i>Urginea maritima</i> -----	-----	(370)
	<i>Uvularia sessilifolia</i> -----	Leaf and flower.	(582)

Family	Genus and species	Source	Reference
<b>Chelidonic Acid—Continued</b>			
Liliaceae-----	<i>Veratrum</i> (7 spp.)-----		(582)
	<i>V. album</i> -----		(370, 637, 684)
	<i>V. viride</i> -----		(370)
	<i>Wurmbea</i> (4 spp.)-----		(582)
	<i>Xerotes elongata</i> -----	Flower	(582)
	<i>X. pauciflora</i> -----	do	(582)
	<i>X. sauveolens</i> -----	do	(582)
Papaveraceae-----	<i>Yucca brevifolia</i> -----	Perianth and pedicel.	(582)
	<i>Zygadenus</i> (5 spp.)-----		(582)
	<i>Chelidonium majus</i> -----	Leaf	(254, 300, 370, 383, 387, 636, 684, 820)
		Leaf, perianth, and pedicel.	(560)
	<i>Stylophorum diphyllum</i> -----	Leaf, perianth, and anther.	(582, 632)
Rhamnaceae-----	<i>Paliurus aculeatus</i> -----	Pedicel	(582)
	<i>Rhamnella franguloides</i> -----	Leaf	(582)
	<i>Rhamnus</i> (21 spp.)-----		(582)
	<i>R. cathartica</i> -----	Fruit	(581)
	<i>Sageretia minutifolia</i> -----	Leaf	(582)
Rubiaceae-----	<i>Zizyphus lotus</i> -----	do	(582)
	<i>Uragoga ipecacuanha</i> ( <i>Cephaelis</i> <i>ipecacuanha</i> )		(370)
Thymelaeaceae-----	<i>Daphne</i> (9 spp.)-----		(582)
	<i>D. gnidium</i> -----	Fruit	(581)
	<i>Gnidia</i> (9 spp.)-----		(582)
	<i>Passerina</i> (5 spp.)-----		(582)
	<i>Pimelea flava</i> -----	Leaf	(582)
	<i>Stellera chamaejasme</i> -----	Leaf and flower	(582)
	<i>Thymelaea</i> (4 spp.)-----		(582)
<i>Wikstroemia</i> (3 spp.)-----			(582)

### Chlorogenic Acid



Acanthaceae-----	<i>Barleria cristata</i> -----		(228)
	<i>Eranthemum</i> <i>macrophyllum</i> .-----		(228)
	<i>Graptobilanthes hortense</i> ( <i>Graptophyllum</i> <i>hortense</i> ).-----		(228)
	<i>Strobilanthes lupinus</i> -----		(228)
	<i>Thunbergia laurifolia</i> -----		(228)

Family	Genus and species	Source	Reference
<b>Chlorogenic Acid—Continued</b>			
Apocynaceae	<i>Allamanda hendersonii</i> -----		(228)
	{ <i>Alstonia scholaris</i> -----		(228)
	<i>Kopsia flava</i> -----		(228, 291)
Aquifoliaceae	{ <i>Ilex aquifolium</i> -----	Leaf, stem, and root.	(118)
	<i>I. salicifolia</i> -----		(228)
	<i>Aralia maculata</i> -----		(228)
Araliaceae	{ <i>Hedera helix</i> -----		(249)
	<i>Heptapleurum</i> sp -----		(228)
	<i>Paratropia</i> sp -----		(228)
	<i>Trevesia sundaica</i> -----		(228)
Asclepiadaceae	<i>Hoya bandanensis</i> -----		(228)
Bignoniaceae	{ <i>Crescentia cujete</i> (C. cujete). -----		(228)
	<i>Kigelia pinnata</i> -----		(228)
	<i>Spathodea campanulata</i> -----		(228)
Boraginaceae	{ <i>Cordia suaveolens</i> -----		(228)
Cannaceae	{ <i>Ehretia buxifolia</i> -----		(228)
	<i>Canna indica</i> -----		(228)
Caprifoliaceae	{ <i>Lonicera</i> sp -----		(228)
	<i>Sambucus javanica</i> -----		(228)
	<i>S. nigra</i> -----	Flower	(118)
Chenopodiaceae	<i>Suaeda dodoneifolia</i> (?) -----		(228)
	95 genera -----		(540)
	<i>Achillea millefolium</i> -----	Flower	(118)
	<i>Anacyclus pyrethrum</i> -----	do	(118)
	<i>Arnica montana</i> -----	do	(118)
	<i>Centaurea jacea</i> -----	Leaf	(118)
	<i>Cichorium intybus</i> -----	do	(118)
	<i>Clibadium asperum</i> -----		(228)
	<i>C. surinamense</i> -----		(228)
	<i>Dahlia variabilis</i> ( <i>D. pinnata</i> ). -----		(539)
	<i>Eupatorium javanicum</i> -----		(228)
	<i>E. pallescens</i> -----		(228)
	<i>Gymnanthemum grande</i> -----		(228)
Compositae	{ <i>Helianthus</i> sp -----	Seed	(230)
	<i>H. annuus</i> -----	do	(224, 229, 364, 494)
	<i>H. doronicoides</i> -----	Leaf	(118)
	<i>H. tuberosus</i> -----		(536, 538, 539)
	<i>Lactuca sativa</i> -----		(538)
	<i>Lappa major</i> ( <i>Arctium majus</i> ). -----	Leaf	(118)
	<i>Pluchea indica</i> -----		(228)
	<i>P. odorata</i> -----		(228)
	<i>Silybum marianum</i> -----		(536)
	<i>Stiftia chrysanthra</i> -----		(228)
	<i>Tagetes erecta</i> -----		(228)
	<i>Taraxacum gymnanthum</i> -----		(539)
	<i>Tithonia diversifolia</i> -----		(228)
	<i>Vernonia</i> sp -----		(228)
	<i>Argyreia kurzei</i> -----		(228)
	<i>Erycibe tomentosa</i> -----		(228)
Convolvulaceae	{ <i>Ipomoea batatas</i> -----	Root	(228, 538, 610)
	<i>Lepistemon flavescens</i> -----		(228)
	<i>Merremia dissecta</i> -----		(228)
	<i>Porana paniculata</i> -----		(228)

Family	Genus and species	Source	Reference
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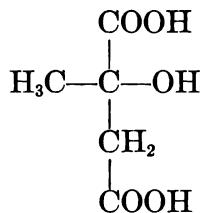
### Chlorogenic Acid—Continued

Cornaceae	<i>Mastixia cuspidata</i>		(228)
Cucurbitaceae	{ <i>Coccinia cordifolia</i>		(228)
	<i>Trichosanthes</i> sp.		(228)
Dipsacaceae	<i>Dipsacus sylvestris</i>		(118)
Ericaceae	<i>Vaccinium lucidum</i>		(228)
Erythroxylaceae	{ <i>Erythroxylon coca</i>		(228)
	<i>E. novogranatense</i>		(228)
Eucommiaceae	<i>Eucommia</i> sp	Leaf	(247)
	{ <i>Aeschynanthus longiflora</i>		(228)
	<i>Agalmiya staminea</i>		(228)
Gesneriaceae	{ <i>Cyrtandra bicolor</i>		(228)
	<i>Episcia pulchella</i>		(228)
	<i>Gloxinia caulescens</i>		(228)
	<i>Sinningia</i> sp		(228)
Gnetaceae	<i>Gnetum ovalifolium</i>		(228)
Goodeniaceae	<i>Scaevola sericea</i>		(228)
	{ Mixed herbage		(299)
	<i>Bambusa</i> sp		(228)
Gramineae	{ <i>Oryza sativa</i>		(228)
	<i>Paspalum vaginatum</i>		(228)
	<i>Phragmites</i> sp		(228)
	<i>Saccharum officinarum</i>		(228)
	{ <i>Ballota foetida</i>	Leaf	(118)
	<i>Calamintha officinalis</i>		(118)
Labiatae	{ <i>Mentha javanica</i>		(228)
	<i>M. rotundifolia</i>		(118)
	<i>Salvia coccinea</i>		(228)
	<i>S. pratensis</i>		(118)
	<i>Stachys lanata</i>		(118)
Liliaceae	<i>Convallaria majalis</i>	Leaf	(118)
Loganiaceae	{ <i>Crateriphytum molukanum</i>		(228)
	<i>Strychnos</i> sp	Seed	(230)
	<i>S. nux-vomica</i>	{ Seed	(228)
Magnoliaceae	<i>Michelia fuscata</i>		(228)
Malvaceae	<i>Gossypium</i> sp		(495)
Martyniaceae	<i>Martynia diandra</i>		(228)
Moraceae	{ <i>Castilla elastica</i>	Latex	(232)
Oleaceae	{ <i>Ficus elastica</i>	do	(232)
	<i>Jasminum nudiflorum</i>	Leaf and flower	(118)
	<i>Orobanche epithymum</i>	Stem	(118)
Orbanchaceae	{ <i>O. rapum</i>	Stem, flower, and under- ground parts.	(118)
	<i>Phelipaea lutea</i>		
Pandanaceae	<i>Freycinetia strobilacea</i>		(118)
Pedaliaceae	<i>Sesamum orientale</i>		(228)
	{ <i>Aconitum septentrionale</i>		(228)
Ranunculaceae	{ <i>Clematis paniculata</i>		(228)
	<i>C. vitalba</i>	Leaf	(118)
	<i>Ranunculus bulbosus</i>	do	(118)
	<i>Crataegus oxyacantha</i>	Fruit, leaf, and flower.	(187)
	<i>Prunus domestica</i>	Fruit	(147)
Rosaceae	{ <i>Pyrus communis</i>	{ do	(94, 779)
		Leaf	(779)
	<i>P. malus</i> ( <i>Malus sylvestris</i> )	{ Fruit	(94, 296, 460,
		Juice	779)
		Leaf	(530, 531)
			(788)



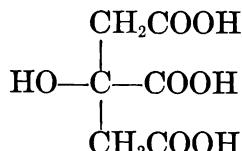
Family	Genus and species	Source	Reference
<b>Cinnamic Acid</b>			
$\begin{array}{c} \text{CH}=\text{CHCOOH} \\   \\ \text{C}_6\text{H}_5 \end{array}$			
Compositae-----	<i>Parthenium argentatum</i> ---	Aqueous extract of root, rub- ber, resin, and leaf.	(78, 764)
Ericaceae-----	<i>Enkianthus japonicus</i> -----	Leaf-----	(166)
Globulariaceae---	{ <i>Globularia</i> spp-----	-----	(264)
	{ <i>G. alypum</i> -----	Stalk and leaf-----	(265)
	{ <i>G. vulgaris</i> -----	-----do-----	(265, 743)
Hamamelidaceae-	{ <i>Liquidambar</i> sp-----	Resin-----	(293, 305)
	{ <i>L. orientalis</i> -----	-----do-----	(718)
	{ <i>L. styraciflua</i> -----	-----do-----	(304, 717)
Lauraceae-----	<i>Cinnamomum</i> sp-----	Leaf-----	(365)
Leguminosae-----	{ <i>Myroxylon pereirae</i> -----	Balsam-----	(212, 268, 356, 361)
	{ <i>M. toluiferum</i> ( <i>M. balsamum</i> ).-----	-----do-----	(110, 117, 146, 212)
Myrtaceae-----	<i>Eugenia jambolana</i> -----	Seed-----	(545)
Scrophulariaceae-	<i>Scrophularia nodosa</i> -----	Root-----	(317)
Styracaceae-----	<i>Styrax liquidus</i> (?)-----	Resin-----	(658)

### Citramalic Acid



Rosaceae-----	<i>Pyrus malus</i> -----	Peel-----	(297, 298)
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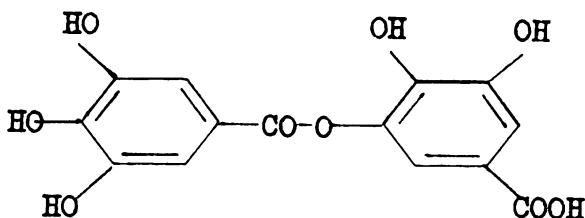
### Citric Acid



Citric acid was first found by Scheele (626, 627) in lemons. Franzen and Helwert (199) have made a critical review of the literature on occurrence of citric acid, and it appears to be ubiquitous in higher plants.

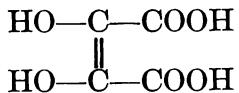
Family	Genus and species	Source	Reference
<b>Coumaric Acid</b>			
$\text{HOC}_6\text{H}_4\text{CH}=\text{CHCOOH}$			
Bignoniaceae-----	{ <i>Catalpa bignonioides</i> ----- <i>C. ovata</i> ----- <i>Daviesia latifolia</i> -----	Leaf ----- Leaf and bark ----- Leaf and stem ----- Vegetative part.	(462) (282) (555) (99)
Leguminosae-----	{ <i>Melilotus alba</i> ----- <i>M. officinalis</i> ----- <i>Trifolium pratense</i> -----	Root ----- Vegetative part. Flower -----	(616) (99) (553)
Papaveraceae-----	<i>Papaver somniferum</i> -----	-----	(635)
Pinaceae-----	<i>Pinus</i> sp. -----	Resin -----	(37)
Rosaceae-----	<i>Prunus serotina</i> -----	Bark -----	(550)

## Digallic Acid

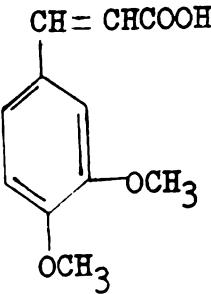
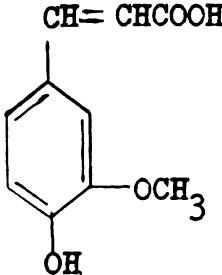


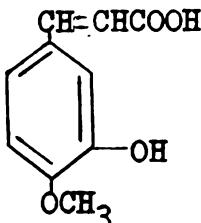
Theaceae----- *Thea sinensis*----- Leaf----- (601, 602)

## Dihydroxymaleic Acid



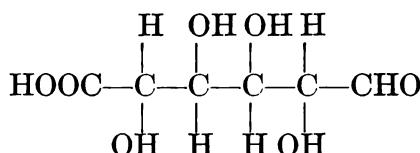
Papaveraceae - - - *Glaucium luteum* - - - Pressed juice--- (634)

Family	Genus and species	Source	Reference
<b>3,4-Dimethoxycinnamic Acid</b>			
			
Scrophulariaceae	<i>Veronica virginica</i> -----	Rhizome and root.	(552)
<b>Ethylmalic Acid</b>			
$\begin{array}{c} \text{CH}_3\text{CH}_2-\text{CH}-\text{COOH} \\   \\ \text{HO}-\text{CH}-\text{COOH} \end{array}$			
Euphorbiaceae	<i>Euphorbia biglandulosa</i> ...	Latex-----	(342)
<b>Ferulic Acid</b>			
			
Bignoniaceae	<i>Catalpa ovata</i> -----	Bark-----	(282)
Pinaceae	<i>Larix europaea</i> ( <i>L. decidua</i> ). -----	Resin-----	(37)
Umbelliferae	<i>Ferula assafoetida</i> -----	Resin of roots and rhizomes.	(638)

Family	Genus and species	Source	Reference
<b>Isoferulic Acid</b>			
			
Bignoniaceae-----	<i>Catalpa ovata</i> -----	Root bark-----	(282)
Ranunculaceae-----	<i>Cimicifuga racemosa</i> -----	Rhizome-----	(188)
<b>Fluoracetic Acid</b>			
$\text{CH}_2\text{FCOOH}$			
Dichapetalaceae..	<i>Dichapetalum cymosum</i> ..	-----	(425)
<b>Fumaric Acid</b>			
$\begin{array}{c} \text{H}-\text{C}-\text{COOH} \\ \parallel \\ \text{HOOC}-\text{C}-\text{C}-\text{H} \end{array}$			
Aceraceae-----	<i>Acer saccharum</i> -----	{ Sirup----- Sugar sand----- Sap and sirup-----	{ (468) (469) (542)
Asclepiadaceae-----	<i>Asclepias syriaca</i> -----	Root-----	(427)
Chenopodiaceae-----	<i>Beta vulgaris</i> -----	Diffusion juice-----	(501, 673)
Compositae-----	<i>Helianthus annuus</i> -----		(58)
Cruciferae-----	<i>Bunias orientalis</i> -----	Stem, leaf, and flowering top.	(316)
Eucommiaceae-----	<i>Eucommia ulmoides</i> -----	Leaf-----	(246)
Euphorbiaceae-----	{ <i>Cluytia similis</i> ----- <i>Ricinus communis</i> -----	Leaf and stem----- Germinating bean.	{ (729) (145)
Gramineae-----	{ <i>Hordeum vulgare</i> ----- <i>Oryza sativa</i> ----- <i>Saccharum officinarum</i> ----- <i>Sorghum</i> sp-----	{ Leaf----- Etiolated shoot----- Seedling----- { Grain----- Leaf----- Juice----- Sirup-----	{ (114) (168) (314) (256) (809) (603, 604, 605) (416)

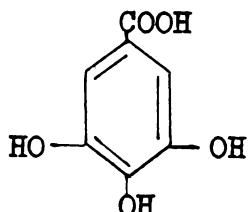
Family	Genus and species	Source	Reference
<b>Fumaric Acid—Continued</b>			
Labiatae	<i>Salvia officinalis</i>	Leaf	(96)
Leguminosae	<i>Davieria latifolia</i>	Leaf and stem	(555)
	<i>Phaseolus coccineus</i>	-----	(58)
	<i>P. mungo</i>	-----	(129)
	<i>Corydalis bulbosa</i>	-----	(781)
Papaveraceae	<i>Fumaria officinalis</i>	Sap	(138, 140, 713, 790)
	<i>Glaucium flavum</i>	Leaf	(486)
	<i>G. luteum</i>	-----	(560, 561, 634)
	<i>Papaver somniferum</i>	-----	(635)
Solanaceae	<i>Nicotiana</i> sp.	-----	(653, 748, 749)
Umbelliferae	<i>Daucus carota</i>	Root tissue	(105, 106, 409)
	<i>Myrrhis odorata</i>	Leaf	(308, 486)

### Galacturonic Acid



Rosaceae	<i>Fragaria vesca</i>	Juice	(447, 448)
	<i>Prunus persica</i>	{ do	(18)
	<i>Pyrus communis</i>	Fruit	(19)
	<i>P. malus</i> ( <i>Malus sylvestris</i> ).	Fruit	(19, 29)
		Juice	(530)

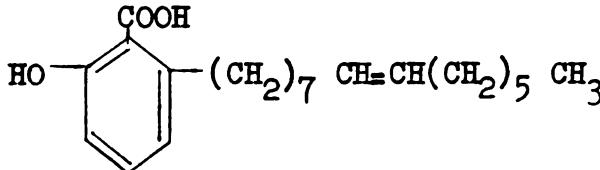
### Gallic Acid



Anacardiaceae	<i>Rhus coriaria</i>	Stalk	(386, 677)
	<i>R. glabra</i>	Fruit	(618)
	<i>R. semialata</i>	do	(734)
Celastraceae	<i>Celastrus scandens</i>	do	(776)
Commelinaceae	<i>Commelina agraria</i>	do	(594)
Cornaceae	<i>Cornus florida</i>	Flower and bract.	(619)
	<i>C. sericea</i>	Fruit pulp	(679)

Family	Genus and species	Source	Reference
<b>Gallic Acid—Continued</b>			
Ericaceae-----	{ <i>Arctostaphylos uvaursi</i> -----	-----	(607)
Euphorbiaceae-----	{ <i>Epigaea repens</i> -----	-----	(502)
	<i>Phyllanthus distichus</i> -----	Root bark-----	(136)
Fagaceae-----	{ <i>Quercus aegilops</i> -----	Acorn-----	(677)
	<i>Q. pedunculata</i> ( <i>Q.</i> <i>robur</i> ). -----	Wood-----	(442)
Geraniaceae-----	{ <i>Geranium onoei</i> -----	-----	(301)
	<i>G. pratense</i> -----	-----	(91)
	<i>G. zonale</i> -----	-----	(93)
Lauraceae-----	<i>Persea gratissima</i> ( <i>P. americana</i> ). -----	Fruit kernel-----	(514, 515)
Leguminosae-----	<i>Pithecellobium saman</i> ( <i>Samanea saman</i> ). -----	Bark-----	(307)
Loganiaceae-----	<i>Gelsemium sempervirens</i> -----	Root-----	(289)
Musaceae-----	<i>Musa paradisiaca</i> -----	Sap-----	(263)
Myrtaceae-----	<i>Psidium</i> spp-----	-----	(515)
Nymphaeaceae-----	<i>Brasenia schreberi</i> -----	-----	(461)
Oleaceae-----	<i>Olea europaea</i> -----	Leaf-----	(115)
Polygonaceae-----	{ <i>Rheum austriacum</i> -----	Root-----	(273)
	<i>R. rhabonticum</i> -----	do-----	(273)
Punicaceae-----	<i>Punica granatum</i> -----	Root bark-----	(772, p. 641, note 1)
Rubiaceae-----	<i>Coffea</i> sp-----	-----	(529)
Sapotaceae-----	<i>Mimusops</i> sp-----	-----	(515)
Scrophulariaceae-----	{ <i>Digatalis</i> sp-----	-----	(88, p. 776)
	<i>D. purpurea</i> -----	-----	(88, p. 776)
Simarubaceae-----	<i>Quassia simaruba</i> -----	Root bark-----	(772, p. 641, note 1)
Solanaceae-----	<i>Nicotiana tabacum</i> -----	Leaf-----	(772, p. 1112, note 2)
Theaceae-----	<i>Thea sinensis</i> -----	-----	(369, 601, 602)

### Ginkgolic Acid

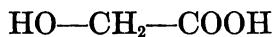


Ginkgoaceae-----	<i>Ginkgo biloba</i> -----	Fruit-----	(334)
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Family	Genus and species	Source	Reference
<b>Gluconic Acid</b>			
	$\begin{array}{ccccccc} & \text{H} & \text{H} & \text{OH} & \text{H} & & \\ &   &   &   &   & & \\ \text{HO} & -\text{CH}_2 & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{COOH} \\ &   &   &   &   & & \\ & \text{OH} & \text{OH} & \text{H} & \text{OH} & & \end{array}$		
Chenopodiaceae	<i>Beta vulgaris</i>	Crust on juice preheater.	(402)
<b>Glucuronic Acid</b>			
	$\begin{array}{ccccc} \text{OH} & \text{H} & \text{OH} & \text{OH} & \text{COOH} \\   &   &   &   &   \\ \text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} \\   &   &   &   &   \\ \text{H} & \text{OH} & \text{H} & \text{H} & \text{H} \\ & & & & \\ & & \text{O} & & \end{array}$		
Compositae	<i>Taraxacum officinale</i>	Young leaf	(504)
Cucurbitaceae	<i>Cucurbita pepo</i>	Seed	(504)
Gramineae	<i>Hordeum vulgare</i>	Germinating seed.	(504)
Leguminosae	<i>Musa sp.</i>	Shoot	(621)
	<i>Phaseolus</i> or <i>Vicia</i>	Germinating seed and etiolated leaf.	(504)
<b>Glutaric Acid</b>			
	$\text{HOOC}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{COOH}$		
Chenopodiaceae	<i>Beta vulgaris</i>	Beet	(395, 396, 742)
<b>Glyceric Acid</b>			
	$\text{CH}_2\text{OH}-\text{CH}(\text{OH})-\text{COOH}$		
Chenopodiaceae	<i>Beta vulgaris</i>	Diffusion juice	(673)
Gramineae	<i>Hordeum vulgare</i>	{ Leaf	(56)
Leguminosae	<i>Glycine sp.</i>	Leaf	(57, 114)
Solanaceae	<i>Nicotiana tabacum</i>	-----	(84)
		-----	(687)

Family	Genus and species	Source	Reference
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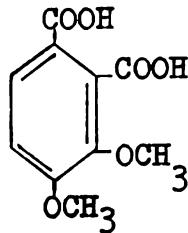
### Glycolic Acid



Caprifoliaceae	<i>Sambucus nigra</i>	Leaf	(34)
Caryophyllaceae	<i>Herniaria glabra</i>	do	(34)
Chenopodiaceae	<i>Beta vulgaris</i>	Beet juice	(396, 501, 672, 673)
Combretaceae	<i>Combretum micranthum</i>	Leaf	(34)
Compositae	{ <i>Cynara scolymus</i>	do	(34)
	<i>Solidago virga-aurea</i>	Flowering twig	(34)
Dichapetalaceae	<i>Dichapetalum cymosum</i>	-----	(425)
Ericaceae	{ <i>Arbutus unedo</i>	Leaf	(34)
	<i>Erica multiflora</i>	Flowering twig	(34)
Euphorbiaceae	{ <i>Ricinus communis</i>	-----	(65, 145)
	<i>Agropyron repens</i>	Root and rhizome.	(34)
	<i>Avena sativa</i>	Seedling	(291)
Gramineae	{ <i>Hordeum vulgare</i>	{ Leaf	(56, 57)
		Etiolated shoot	(114, 687)
	<i>Saccharum officinarum</i>	Seedling	(168)
		Juice	(291)
	<i>Zea mays</i>	Stigmata	(34)
Labiatae	<i>Lavandula vera</i>	Flowering twig	(34)
	<i>Orthosiphon stamineus</i>	Leaf	(34)
	<i>Rosmarinus</i> spp	Flowering twig	(34)
Leguminosae	{ <i>Lupinus albus</i>	Seedling	(291)
	<i>Medicago sativa</i>	Sap	(185)
	<i>Pisum sativum</i>	Seedling	(291)
	<i>Asparagus</i> spp	Root and rhizome.	(34)
Liliaceae	<i>Ruscus aculeatus</i>	do	(34)
Pinaceae	<i>Juniperus communis</i>	Berry	(34)
Rosaceae	{ <i>Prunus cerasus</i>	Peduncle	(34)
	<i>Pyrus communis</i>	Juice	(592)
	<i>P. malus</i> ( <i>Malus sylvestris</i> )	do	(700)
Solanaceae	{ <i>Nicotiana tabacum</i>	Leaf	(687)
	<i>Physalis alkekengi</i>	Berry	(34)
	<i>Solanum lycopersicum</i> ( <i>Lycopersicon esculentum</i> )	Leaf	(686, 687)
	<i>Apium graveolons</i>	Root and rhizome.	(34)
Umbelliferae	{ <i>Eryngium campestre</i>	do	(34)
	<i>Foeniculum vulgare</i>	do	(34)
	<i>Petroselinum sativum</i> ( <i>P. crispum</i> )	do	(34)
Urticaceae	<i>Parietaria</i> spp	Leaf	(34)
Vitaceae	{ <i>Ampelopsis hederacea</i> ( <i>Parthenocissus quinquefolia</i> )	do	(235)
	<i>Vitis vinifera</i>	{ Unripe fruit Fruit	(101, 183, 184) (280)

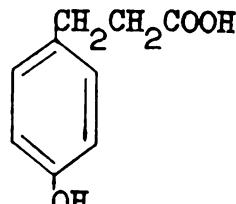
Family	Genus and species	Source	Reference
<b>Glyoxalic Acid</b>			
$\begin{array}{c} \text{CHO} \\   \\ \text{COOH} \end{array}$			
Chenopodiaceae	<i>Beta vulgaris</i>	-----	(396)
Cornaceae	<i>Cornus mas</i>	Fruit	(631)
Ericaceae	<i>Vaccinium oxyccocos</i>	-----	(682)
Gramineae	<i>Saccharum officinarum</i>	Juice	(784)
Labiatae	<i>Mentha piperita</i>	Leaf	(709, 711)
Leguminosae	<i>Arachis hypogaea</i>	Seedling	(195, 196)
Liliaceae	<i>Tulipa gesneriana</i>	-----	(709, 710)
Polygonaceae	<i>Rheum officinale</i>	-----	(102)
Rosaceae	<i>Prunus domestica</i>	Unripe fruit	(102)
	<i>Pyrus malus (Malus sylvestris).</i>	{ do -----	(298)
Saxifragaceae	<i>Ribes sp.</i>	Fruit	(102)
	<i>R. grossularia</i>	Unripe fruit	(102)
	<i>do</i>	do	(102)
Solanaceae	<i>Solanum tuberosum</i>	Tuber	(711)
Umbelliferae	<i>Daucus carota</i>	{ Leaf and root	(709)
		Root	(711)
Vitaceae	<i>Vitis vinifera</i>	-----	(102, 103, 248, 280)
		Juice	(647)

### Hemipinic Acid

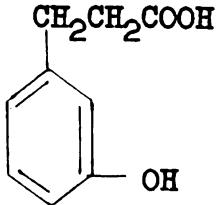


Papaveraceae	<i>Papaver somniferum</i>	-----	(635)
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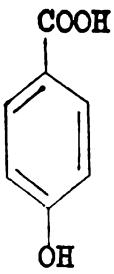
### Hydrocaffeic Acid

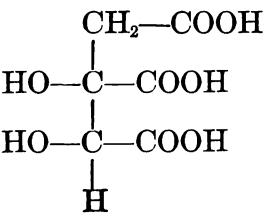


Chenopodiaceae	<i>Beta vulgaris</i>	Leaf	(397)
Solanaceae	<i>Solanum tuberosum</i>	Tuber	(587)
Vitaceae	<i>Ampelopsis hederacea</i> ( <i>Parthenocissus quinquefolia</i> ).	-----	(587)

Family	Genus and species	Source	Reference
<b>Hydrocoumaric Acid</b>			
			

Leguminosae ----- *Melilotus officinalis* ----- (822)

<b>p-Hydroxybenzoic Acid</b>			
			
Bignoniaceae -----	{ <i>Bignonia catalpa</i> -----	Unripe fruit -----	(534)
	<i>Catalpa ovata</i> -----	Leaf -----	(462)
Papaveraceae -----	<i>Papaver somniferum</i> -----		(635)

<b>Hydroxycitric Acid</b>			
			

Chenopodiaceae .. *Beta vulgaris* ----- Juice ----- (395)

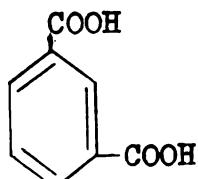
<b>alpha-Hydroxyglutaric Acid</b>			
		HOOC—CH <sub>2</sub> CH <sub>2</sub> CHOH—COOH	

Chenopodiaceae .. *Beta vulgaris* ----- Sap ----- (394)



Family	Genus and species	Source	Reference
<b>Isocitric Acid</b>			
	$\begin{array}{c} \text{CH(OH)}-\text{COOH} \\   \\ \text{CH}-\text{COOH} \\   \\ \text{CH}_2-\text{COOH} \end{array}$		
Anonaceae-----	<i>Annona muricata</i> -----	Leaf-----	(479)
	<i>Bryophyllum</i> sp-----	Leaf-----	(80, 505, 572)
	<i>B. calycinum</i> -----	do-----	(109, 362, 563, 564, 566, 568, 686, 687, 738, 747).
Crassulaceae-----	<i>Escheveria</i> sp-----	Leaf and stem-----	(567)
	<i>E. secunda</i> -----	Leaf-----	(362)
	<i>Sedum acre</i> -----	-----	(484, 485)
	<i>S. maximum</i> -----	-----	(485)
	<i>S. praealtum</i> -----	-----	(803)
	<i>Sempervivum tectorum</i> -----	-----	(485)
Gramineae-----	<i>Hordeum vulgare</i> -----	Leaf-----	(56)
Lecythidaceae-----	<i>Couroupita guianensis</i> -----	Fruit-----	(57, 589)
Leguminosae-----	<i>Pisum sativum</i> -----	Ungerminated seeds.	(476)
Rosaceae-----	<i>Pyrus malus (Molus sylvestris)</i> .-----	Fruit-----	(424)
	<i>Rubus fruticosus</i> -----	do-----	(105, 106)
Serophulariaceae-----	<i>Digitalis purpurea</i> -----	Leaf-----	(331)
Solanaceae-----	<i>Nicotiana tabacum</i> -----	Leaf-----	(362)
	<i>Solanum lycopersicum (Lycopersicon esculentum)</i> .-----	Leaf-----	(686)
	<i>S. tuberosum</i> -----	Leaf-----	(687)
Umbelliferae-----	<i>Daucus carota</i> -----	Juice of tuber--	(686, 687)
		-----	(126)
		-----	(105, 106)

### Isophthalic Acid



Iridaceae-----	<i>Iris versicolor</i> -----	Rhizome-----	(554)
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### alpha-Ketoadipic Acid



Leguminosae-----	<i>Pisum sativum</i> -----	Germinating seed.	(753)
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Family	Genus and species	Source	Reference
<b>alpha-Ketoglutaric Acid</b>			
$\text{HOOC}-\text{CH}_2-\text{CH}_2-\text{CO}-\text{COOH}$			
Euphorbiaceae---	<i>Ricinus communis</i> -----	Germinating seed.	(145)
Gramineae-----	<i>Hordeum vulgare</i> -----	Etiolated shoot.	(168)
Labiatae-----	<i>Mentha piperita</i> -----	Leaf-----	(709, 711)
Leguminosae-----	{ <i>Arachis hypogaea</i> ----- <i>Pisum sativum</i> ----- <i>Trifolium pratense</i> -----	Seedling----- Young plant----- -----	(195, 196) (757, 759) (756, 757)
Liliaceae-----	<i>Tulipa gesneriana</i> -----	-----	(709, 710)
Rosaceae-----	<i>Prunus malus</i> ( <i>Malus sylvestris</i> )	Fruit-----	(298)
Solanaceae-----	<i>Solanum tuberosum</i> -----	Tuber-----	(38, 711)
Umbelliferae-----	<i>Daucus carota</i> -----	{ Root and leaf----- Root-----	(709) (711)

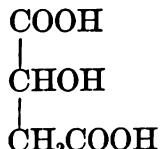
### Lactic Acid



Amaryllidaceae---	<i>Agave sisalana</i> -----	Leaf-----	(414, 640, 641)
Bromeliaceae----	<i>Ananas sativas</i> ( <i>A. comosus</i> ).-----	-----	(515)
Chenopodiaceae--	<i>Beta vulgaris</i> -----	{ Juice----- Root----- Root and leaf-----	(438) (672, 673) (680, 681)
Compositae-----	{ <i>Helianthus annuus</i> ----- <i>Lactuca</i> sp.----- <i>L. sativa</i> -----	{----- Leaf----- Leaf-----	(742) (58) (515) (640) (641)
Crassulaceae----	<i>Bryophyllum calycinum</i> -----	-----	(801)
Cruciferae-----	<i>Brassica oleracea</i> -----	{ Fresh and fermented kale. Cabbage leaf-----	(42)
Cucurbitaceae----	<i>Cucumis sativus</i> -----	-----	(641)
Ericaceae-----	<i>Vaccinium myrtillus</i> -----	-----	(680) (825) (137)
Euphorbiaceae---	<i>Ricinus communis</i> -----	{ Germinating seed. Seedling----- Seedling and leaf.	(145, 294) (640) (641)
Fagaceae-----	{ <i>Castanea vesca</i> ( <i>C. sativa</i> )----- <i>Fagus sylvatica</i> -----	Fruit----- Nut-----	(148) (327)
Gentianaceae-----	{ <i>Erythraea centaurium</i> ----- <i>Bambusa</i> sp.-----	Shoot----- -----	(253) (621)
Gramineae-----	{ <i>Hordeum distichum</i> ----- <i>H. sativum</i> ----- <i>H. vulgare</i> ----- <i>Oryza</i> spp.----- <i>Secale cereale</i> ----- <i>Triticum sativum</i> ( <i>T. aestivum</i> ).----- <i>T. vulgare</i> ----- <i>Zea mays</i> -----	Germinating seed. ----- Etiolated shoot. Leaf----- do----- do----- do----- do----- do----- do-----	(681) (793) (168) (809) (668) (668) (640, 641, 793)

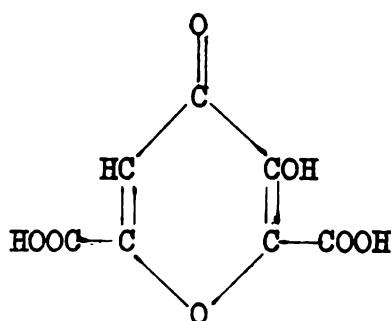
Family	Genus and species	Source	Reference
<b>Lactic Acid—Continued</b>			
Leguminosae-----	{ <i>Glycine</i> sp-----	-----	(327)
	<i>Lupinus</i> sp-----	Seed-----	(456)
	<i>L. luteus</i> -----	Germinating seed.	(681)
	<i>Phaseolus coccineus</i> -----	-----	(58)
	<i>P. vulgaris</i> -----	Seedling-----	(641)
	<i>Pisum sativum</i> -----	Germinating seed.	(640, 641, 681)
	<i>Tamarindus indica</i> -----	-----	(3, 325)
	<i>Vicia faba</i> -----	{ Leaf and sprout. Germinating seed.	(640, 641) (681)
Malvaceae-----	<i>Gossypium</i> sp-----	Seed-----	(327)
Myricaceae-----	<i>Myrica rubra</i> -----	Fruit-----	(354)
Myrsinaceae-----	<i>Maesa picta</i> -----	Seed-----	(22)
Papaveraceae-----	{ <i>Glaucium luteum</i> -----	Pressed juice-----	(684)
Polygonaceae-----	<i>Papaver somniferum</i> -----	“Poppy straw”-----	(636)
	<i>Rheum</i> sp-----	Leaf-----	(640)
	<i>R. hybridum</i> -----	Tuber-----	(641)
	<i>Eriobotrya japonica</i> -----	Milky juice-----	(128, p. 93, ftn. 12)
Rosaceae-----	<i>Fragaria</i> sp-----	Juice of fruit-----	(281)
	<i>Prunus avium</i> -----	-----	(197)
	<i>P. cerasus</i> -----	Juice of fruit-----	(437)
	<i>Pyrus communis</i> -----	{ do-----	(437) (592)
	<i>P. malus (Malus sylvestris)</i> -----	{ Juice and fruit----- Fruit-----	(200, 281) (436, 437, 702)
Rutaceae-----	<i>Rubus</i> sp-----	Leaf-----	(640)
	<i>R. fruticosus</i> -----	do-----	(203, 204, 641)
	<i>R. idaeus</i> -----	do-----	(210, 211, 642) (281)
Salicaceae-----	<i>Citrus decumana (C. grandis)</i> -----	Juice of fruit-----	
	<i>Salix</i> sp-----	Bark-----	(151)
Scrophulariaceae-----	{ <i>Digatalis purpurea</i> -----	-----	(331)
	<i>Euphrasia officinalis</i> -----	-----	(172)
	<i>Veronica officinalis</i> -----	-----	(171)
	<i>Solanum dulcamara</i> -----	Peduncle-----	(800)
Solanaceae-----	<i>S. lycopersicum (Lyc- opersicon esculentum)</i> .-----	{ Fruit----- Juice of fruit-----	(109, 116, 737) (595)
	<i>S. tuberosum</i> -----	Tuber-----	(39, 40, 640, 641, 680, 681, 778, 793)
	<i>Theobroma cacao</i> -----	Seed-----	(453)
Umbelliferae-----	<i>Daucus carota</i> -----	{ Root----- Juice-----	(640) (641, 681)
	<i>Vitis vinifera</i> -----	Sap-----	(437) (799)

### Malic Acid

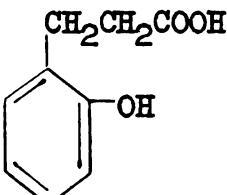


Malic acid was discovered by Scheele (628), who reported its presence in a number of plants. Franzen and Keyssner (804) have made a critical review of the literature on its occurrence, but it appears to be ubiquitous in higher plants.

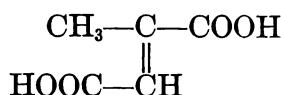
## Iaconic Acid



Papaveraceae	<table border="0"> <tr> <td><i>Papaver rhoes</i></td><td>-----</td><td>(510)</td></tr> <tr> <td><i>P. somniferum</i></td><td> <table border="0"> <tr> <td>Dried capsules</td><td>-----</td><td>(66)</td></tr> <tr> <td>Milky sap</td><td>-----</td><td>(141)</td></tr> </table> </td><td>(1, p. 1337, ftn. 1)</td></tr> </table>	<i>Papaver rhoes</i>	-----	(510)	<i>P. somniferum</i>	<table border="0"> <tr> <td>Dried capsules</td><td>-----</td><td>(66)</td></tr> <tr> <td>Milky sap</td><td>-----</td><td>(141)</td></tr> </table>	Dried capsules	-----	(66)	Milky sap	-----	(141)	(1, p. 1337, ftn. 1)	
<i>Papaver rhoes</i>	-----	(510)												
<i>P. somniferum</i>	<table border="0"> <tr> <td>Dried capsules</td><td>-----</td><td>(66)</td></tr> <tr> <td>Milky sap</td><td>-----</td><td>(141)</td></tr> </table>	Dried capsules	-----	(66)	Milky sap	-----	(141)	(1, p. 1337, ftn. 1)						
Dried capsules	-----	(66)												
Milky sap	-----	(141)												

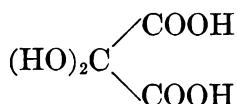
Family	Genus and species	Source	Reference
<b>Melilotic Acid</b>			
			
Leguminosae-----	{ <i>Melilotus alba</i> -----	Vegetative part-----	(99)
	<i>M. officinalis</i> -----	do-----	(99, 822)
Solanaceae-----	<i>Nicotiana tabacum</i> -----	Leaf-----	(772, p. 1112, note 2)

### Mesaconic Acid



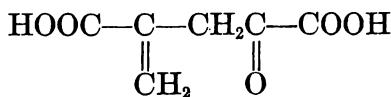
Bignoniaceae-----	<i>Crescentia</i> sp-----	Curare-----	(330)
Cruciferae-----	<i>Brassica oleracea</i> -----	Leaf-----	(111, 112)
Gramineae-----	<i>Saccharum officinarum</i> -----	Juice-----	(603, 604, 605)

### Mesoxalic Acid



Leguminosae-----	<i>Medicago sativa</i> -----	-----	(185)
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### gamma-Methylene-alpha-Ketoglutaric Acid



Leguminosae-----	<i>Arachis hypogaea</i> -----	Seedling-----	(195, 196)
Liliaceae-----	<i>Tulipa gesneriana</i> -----	-----	(709, 710)

Family	Genus and species	Source	Reference
<b>Morolic Acid</b>			

Ericaceae ----- *Agauria salicifolia* ----- (158)

<b>Mucic Acid</b>			
	$\begin{array}{ccccccc} & \text{H} & \text{OH} & \text{OH} & \text{H} & & \\ &   &   &   &   & & \\ \text{HOOC} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{COOH} & \\ &   &   &   &   & & \\ & \text{OH} & \text{H} & \text{H} & \text{OH} & & \end{array}$		
Chenopodiaceae .....	<i>Beta vulgaris</i> .....	Diffusion juice .....	(672)
Elaeocarpaceae .....	<i>Elaeocarpus serratus</i> .....	Fruit pulp .....	(870)
Rosaceae -----	$\left\{ \begin{array}{l} \text{Prunus persica} \\ \text{Pyrus communis} \end{array} \right.$ .....	Ripe fruit .....	(19)
		do .....	(19)

<b>Neoabietic Acid</b>			

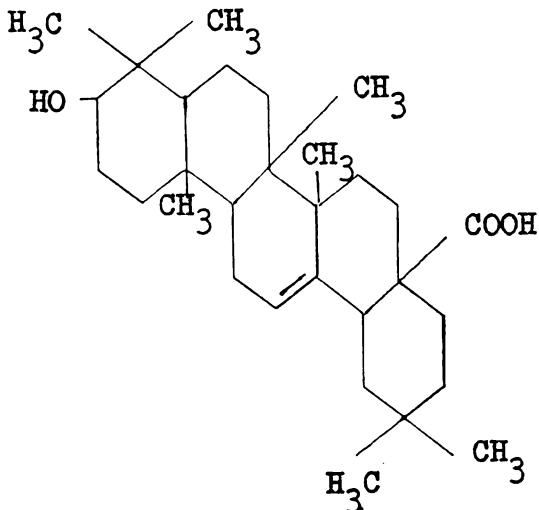
Pinaceae -----  $\left\{ \begin{array}{l} \text{Pinus palustris} \\ \text{P. sylvestris} \end{array} \right.$  ----- Oleoresin .....

Oleoresin and  
wood resin.

(258)  
(259)

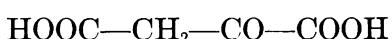
Family	Genus and species	Source	Reference
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### Oleanolic Acid



Apocynaceae	<i>Alyxia buxifolia</i>	Bark	(21)
Ericaceae	<i>Vaccinium myrtillus</i>	-	(583)
Euphorbiaceae	<i>Petalostigma sericeum</i>	-	(21)
Labiatae	{ <i>Salvia officinalis</i>	-	(97)
	<i>Thymus vulgaris</i>	-	(609)
Loranthaceae	<i>Viscum album</i>	Leaf	(795)
Myrtaceae	<i>Psidium guajava</i>	do	(27)
Oleaceae	<i>Olea europaea</i>	do	(252)
Rosaceae	{ <i>Crataegus oxyacantha</i>	do	(60)
	<i>Eriobotrya japonica</i>	do	(26)
Solanaceae	{ <i>Anthocercis intricata</i>	Bark	(21)
	<i>A. littorea</i>	do	(21)
	<i>A. odgersii</i>	do	(21)
Vitaceae	<i>Vitis labrusca</i>	Pomace	(439)

### Oxalacetic Acid



Gramineae	{ <i>Hordeum vulgare</i>	-	(756)
	<i>Phleum pratense</i>	-	(756)
Labiatae	<i>Mentha piperita</i>	-	(709, 711)
	{ <i>Canavalia ensiformis</i>	-	(756)
Leguminosae	<i>Pisum sativum</i>	-	(755, 756, 757,
	{ <i>Trifolium pratense</i>	Young leaf	758, 759)
Liliaceae	<i>Tulipa gesneriana</i>	-	(754, 755,
Rosaceae	<i>Pyrus malus (Malus</i>	Fruit	756, 757)
	<i>sylvestris</i> )	-	(709, 710)
Solanaceae	<i>Solanum tuberosum</i>	Tuber	(298)
Umbelliferae	<i>Daucus carota</i>	{ Root and leaf	(711)
		Root	(709)
		-	(711)

Family	Genus and species	Source	Reference	
<b>Oxalic Acid</b>				
	COOH   COOH			
	[Reviews and surveys of the occurrence of oxalic acid include those of Andrews and Viser (17), Esbach (475, p. 1909), Kohman (350, 351), Meyen (443, p. 122), Miller, Ross, and Lewis (446), Molisch (450), Pat-schovsky (508), Schimper (630), and Treviranus (128, p. 66, note 6)]			
Aceraceae	{ <i>Acer platanoides</i> ----- <i>A. saccharum</i> -----	Root----- Sap and sugar sand.	(359) (768)	
Aizoaceac	{ <i>Mesembryanthemum</i> sp. ----- <i>M. acinaciforme</i> ----- <i>M. crystallinum</i> -----	----- ----- { Leaf and flower-----	(509) (2) (16, 63) (62)  { <i>Alternanthera sessilis</i> ----- <i>Amaranthus</i> sp. ----- <i>A. aquatica</i> (?) -----	(509) (292) (236) (622)
Amarantaceae	{ <i>A. caudatus</i> ----- <i>A. gangeticus</i> ----- <i>A. polygonoides</i> -----	{ Leaf and flower----- ----- -----	(62) (63) (292) (292)	
Amaryllidaceae	<i>Agave americana</i> -----	Leaf-----	(815)	
Anacardiaceae	<i>Mangifera indica</i> -----	-----	(86)	
Araceae	{ <i>Acorus calamus</i> ----- <i>Arum italicum</i> -----	----- Berry-----	(810) (343)	
Aristolochiaceae	<i>Asarum</i> sp. -----	-----	(509)	
Balsaminaceae	{ <i>Impatiens parviflora</i> ----- <i>I. sultani</i> -----	----- -----	(455) (455) (220)	
Begoniaceae	{ <i>Begonia</i> sp. ----- <i>B. evansiana</i> ----- <i>B. rex</i> -----	----- ----- -----	(650, 651, 652) (760)	
Berberidaceae	<i>Berberis vulgaris</i> -----	Fruit-----	(343)	
Betulaceae	{ <i>Alnus</i> sp. ----- <i>Betula</i> sp. -----	Leaf-----	(771) (359)	
Bombacaceae	<i>Adansonia digitata</i> -----	Fruit-----	(5)	
Bromeliaceae	<i>Bromolia pinguin</i> . -----	do-----	(28)	
Cactaceae	{ <i>Cereus peruvianus</i> ----- <i>Opuntia</i> sp. ----- <i>O. vulgaris</i> -----	----- ----- Stem-----	(509) (728) (478)	
Caprifoliaceae	{ <i>Sambucus nigra</i> ----- <i>Syphoricarpos</i> sp. ----- <i>Dianthus barbatus</i> ----- <i>D. carthusianorum</i> ----- <i>Lychnis coronaria</i> ----- <i>L. dioica</i> ----- <i>L. flos-jovis</i> ----- <i>L. githago</i> ( <i>Agrostemma githago</i> ) -----	Young leaf----- Leaf----- Leaf and stem----- Leaf----- Leaf----- Leaf----- Leaf----- Leaf-----	(47) (771) (492) (12) (74) (12, 74, 91) (74) (12)	
Caryophyllaceae	<i>Saponaria</i> sp. ----- <i>S. officinalis</i> ----- <i>Spergula arvensis</i> ----- <i>Stellaria media</i> ----- <i>Tunica saxifraga</i> -----	----- ----- ----- ----- -----	(478) (12) (74) (492) (12)	
Celastraceae	{ <i>Celastrus obscurus</i> ----- <i>Euonymus japonicus</i> -----	Leaf-----	(154) (2)	

Family	Genus and species	Source	Reference
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### Oxalic Acid—Continued

Chenopodiaceae	<i>Atriplex</i> sp.	Juice Root and leaf Leaf Swiss chard, mangold, and beet leaf. Seed Root	(446) (509) (492, 509, 533, 622) (396, 444, 501, 672, 673) (418, 742) (33, 454, 615, 624) (625)
	<i>Beta vulgaris</i>		
	<i>Chenopodium</i> sp.		(509)
	<i>C. quinoa</i>		(62, 63)
	<i>Halogeton glomeratus</i>		(191, 290) (23, 90, 381, 475, 509, 533)
	<i>Spinacia oleracea</i>		(46, 69, 150, 236, 492, 615, 782, 910) (455)
	<i>Callisia repens</i>		(509)
	<i>Tradescantia</i> sp.		(53, 777)
	<i>T. fluminensis</i>		
	<i>T. sellii</i>		(630)
Commelinaceae	<i>T. virginica</i>	Leaf do	(343)
	<i>Cichorium endivia</i>		(23)
	<i>Helianthus tuberosus</i>		(226)
	<i>Kleinia articulata</i>		(312)
	<i>Lactuca</i> spp.		(515)
Convolvulaceae	<i>L. sativa</i>	Leaf Fruit pulp	(475, 633, 782)
	<i>Ipomoea aquatica</i>		(392)
Crassulaceae	<i>Cornus sericea</i>	Fruit pulp	(679)
	<i>Bryophyllum calycinum</i>	Leaf Leaf and stem Leaf do Leaf do do do do	(109, 563, 568, 573, 686, 687, 738)
	<i>B. crenatum</i>		(567)
	<i>Echeveria glauca</i>		(80, 343)
	<i>Sedum azureum</i>		(343)
	<i>S. fabaria</i>		(16)
	<i>Sempervivum glaucum</i>		(343)
	<i>S. tectorum</i>		(52)
	<i>Brassica oleracea</i>		(343)
	<i>B. pekinensis</i>		(509)
Cruciferae	<i>Bunias orientalis</i>	Stem, leaf, and flowering top.	(23, 475)
	<i>Cucumis melo</i>		(810)
	<i>Cucurbita pepo</i>		(316)
Dipsacaceae	<i>Succisa pratensis</i>	Leaf	(23, 533)
Ericaceae	<i>Vaccinium myrtillus</i>		(782)
Euphorbiaceae	<i>Aleurites cordata</i>		(492)
	<i>Euphorbia</i> sp.		(23, 325)
	<i>Mercurialis annuelle</i>		(221)
	<i>M. perennis</i>		(509)
	<i>Phyllanthus emblica</i>		(130)
Fagaceae	<i>Ricinus communis</i>	Leaf Fag. sylvatica Quercus pedunculata	(492)
	<i>Fagus sylvatica</i>		(326)
	<i>Quercus pedunculata</i>		(65)
			(95, 492, 646)
			(442)

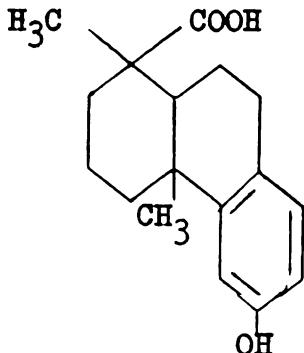
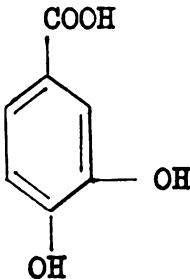
Family	Genus and species	Source	Reference
<b>Oxalic Acid—Continued</b>			
Gesneraceae	<i>Aeschynanthus</i> sp-----	-----	(509)
Globulariaceae	<i>Globularia</i> spp-----	-----	(264)
	<i>Avena sativa</i> -----	Seedling-----	(509)
	<i>Bambusa</i> sp-----	Shoot-----	(621)
	<i>Hordeum vulgare</i> -----	{Leaf----- Seedling-----	(47, 687) (291, 314, 474, 686)
	<i>Lolium perenne</i> -----	-----	(420)
	<i>Oplismenus imbecillus</i> ( <i>O. undulatifolius</i> ). -----	-----	(53)
Gramineae	<i>Oryza</i> spp-----	Leaf-----	(809)
	<i>Phyllostachys mitis</i> -----	Sprout-----	(695)
	<i>Poa pratensis</i> -----	-----	(533)
	<i>Saccharum officinarum</i> -----	Juice-----	(85; 512; 603; 604; 605; 699; 704, ref. 162; 811)
	<i>Secale cereale</i> -----	-----	(474)
	<i>Sorghum</i> sp-----	Juice-----	(416)
	<i>S. vulgare</i> -----	{Leaf-----	(786, 787)
	<i>Triticum</i> sp-----	-----	(802)
	<i>T. aestivum</i> -----	-----	(473)
Hippocastanaceae	<i>Zea mays</i> -----	-----	(53, 761)
Hydrocharitaceae	<i>Aesculus hippocastanum</i> -----	Young leaf-----	(47)
	<i>Elodea canadensis</i> -----	-----	(459)
Juglandaceae	<i>E. densa</i> -----	-----	(459)
Labiatae	<i>Juglans regia</i> -----	Bark-----	(353)
	<i>Acacia</i> spp-----	Bark-----	(509)
	<i>Acacia cambagei</i> -----	Bark and wood-----	(674, 675)
	<i>Arachis hypogaea</i> -----	Kernel-----	(585)
	<i>Cassia</i> sp-----	Leaf-----	(763)
	<i>Cicer arietinum</i> -----	{Secretion from hairs----- Fruit-----	(449)
	<i>Glycine soja</i> ( <i>G. max</i> ) -----	-----	(818)
	<i>Lupinus albus</i> -----	Seedling-----	(533)
Leguminosae	<i>L. luteus</i> -----	Seed-----	(291)
	<i>Medicago sativa</i> -----	-----	(600)
	<i>Mimosa spegazzinii</i> -----	-----	(533)
	<i>Phaseolus limensis</i> ( <i>P.</i> <i>lunatus</i> ). -----	-----	(455)
	<i>Pisum sativum</i> -----	Seedling-----	(533)
	<i>Tamarindus indica</i> -----	{Mature leaf-----	(291)
	<i>Vicia</i> sp-----	-----	(318, 336)
	<i>Vicia faba</i> -----	-----	(28)
	<i>Agapanthus umbellatus</i> -----	Leaf-----	(509)
Liliaceae	<i>Allium cepa</i> -----	-----	(343)
	<i>Asparagus officinalis</i> -----	-----	(8; 77, p. 165, ref. 4; 360, 782)
	<i>Erythronium denscanis</i> -----	Bulb-----	(29)
	<i>Hyacinthus orientalis</i> -----	do-----	(153)
	<i>Smilacina bifolia</i> (?) -----	Fruit----- do-----	(75)
Loranthaceae	<i>S. racemosa</i> -----	-----	(163)
Malvaceae	<i>Viscum</i> sp-----	-----	(163)
	<i>Gossypium</i> sp-----	-----	(509)
			(180, 181, 182, 412)

Family	Genus and species	Source	Reference
<b>Oxalic Acid—Continued</b>			
Melastomaceae	<i>Memecylon tinctorium</i>	-----	(155)
Menispermaceae	<i>Jateorhiza columba</i>	-----	(724)
Moraceae	{ <i>Cannabis</i> sp.	-----	(180)
	{ <i>Ficus carica</i>	-----	(236)
Musaceae	<i>Musa sapientum</i> ( <i>M. par-</i> <i>adisiaca sapientum</i> )	Overripe fruit	(482)
Myricaceae	<i>Myrica rubra</i>	Fruit	(354)
Myristicaceae	<i>Myristica surinamensis</i>	Seed	(715)
Myrtaceae	<i>Eucalyptus</i> (12 spp.)	Bark	(665)
	<i>Psidium guajava</i>	Leaf	(10)
Nyctaginaceae	<i>Mirabilis</i> sp.	Flower and fruit	(535)
Nymphaeaceae	{ <i>Nymphaea alba</i>	Rhizome	(244)
	{ <i>N. lutea</i>	do	(244)
Orchidaceae	{ <i>Vanilla planifolia</i>	-----	(509)
	{ <i>Averrhoa carambola</i>	{ Fruit	(767)
		Juice	(120)
		-----	(385)
		-----	(472)
Oxalidaceae	{ <i>Oxalis</i> sp.	Leaf	(220, 236, 509)
	{ <i>O. acetosella</i>	-----	(343, 429)
	{ <i>O. corniculata</i>	-----	(237)
	{ <i>O. stricta</i>	-----	(68)
	{ <i>O. violacea</i>	-----	(515)
Papaveraceae	{ <i>Fumaria officinalis</i>	Seedcoat	(509)
Pedaliaceae	<i>Sesamum indicum</i>	Seed	(262)
Phytolaccaceae	{ <i>Phytolacca</i> sp	Shoot, bark, and	(509)
	{ <i>P. dioica</i>	pith.	(2)
		-----	(608)
Pinaceae	{ <i>Pinus abies</i> ( <i>Picea abies</i> )	Sap	(324, 646)
	{ <i>P. cembra</i>	Seedling	(644)
	{ <i>P. excelsa</i> ( <i>Picea abies</i> )	Needle	(492, 813)
Piperaceae	<i>Peperomia</i> sp	-----	(509)
	<i>Emex</i> sp	-----	(509)
	<i>Fagopyrum esculentum</i>	{ Leaf and stem	(53, 633)
	<i>Oxyria</i> sp	-----	(577)
	<i>Polygonum</i> sp	-----	(509)
	<i>Rheum</i> sp	{ Leaf	(23, 104, 236, 381,
		Stem	509, 750, 782)
	<i>R. crispum</i> (?)	Leaf	(676)
		Stem	(499)
		{ Leaf and rhizome	(9)
	<i>R. hybridum</i>	Leaf	(565, 576, 687,
		Stem and rhizo-	760)
		zome.	(612, 613)
Polygonaceae	<i>R. leucorrhizum</i>	Stem	(499)
	<i>R. mepalense</i>	do	(499)
	<i>R. nutans</i>	do	(499)
	<i>R. officinale</i>	Leaf	(102, 760)
	<i>R. palmatum</i>	Stem	(499)
	<i>R. "Paragon"</i>	do	(499)
	<i>R. rhabonticum</i>	do	(375)
	<i>R. undulatum</i>	Petiole	(843)
	<i>Rumex</i> sp	{ Leaf	(220, 236, 509)
		Seed and root	(45)
		-----	(63)
	<i>R. acetosa</i>	-----	(23, p. 99, <i>ftn.</i>
			2; 61; 515)
		Root	(359)

Family	Genus and species	Source	Reference
<b>Oxalic Acid—Continued</b>			
Polypodiaceae	<i>Lonchitis</i> sp-----	-----	(509)
Portulacaceae	{ <i>Portulaca</i> sp----- <i>Talinum speciosum</i> -----	-----	(236, 509) (292)
Primulaceae	{ <i>Primula elatior</i> -----	-----	(509) (492)
Punicaceae	<i>Punica granatum</i> -----	{ Bark	(326) (478)
Pyrolaceae	<i>Monotropa</i> sp-----	-----	(509)
Ranunculaceae	{ <i>Anemone</i> sp----- <i>A. nemorosa</i> -----	-----	(509) (732)
Rhamnaceae	{ <i>Rhamnus lycioides</i> ----- <i>Zizyphus jujuba</i> -----	Leaf	(77, p. 165, ref. 4) (326)
	<i>Crataegus</i> sp-----	Leaf	(771)
	<i>C. oxyacantha</i> -----	do	(47)
	<i>Fragaria</i> sp-----	{ Fruit	(6) (23, 782)
	<i>Mespilus germanica</i> -----	Overripe fruit	(482)
	<i>Prunus armeniaca</i> -----	Dried fruit	(464)
	<i>P. avium</i> -----	Fruit	(197)
	<i>P. cerasus</i> -----	do	(23, 337)
Rosaceae	<i>P. domestica</i> -----	do	(23, 104)
	<i>P. persica</i> -----	do	(23)
	<i>Pyrus communis</i> -----	{ do	(23) (482)
	<i>P. malus</i> ( <i>Malus sylvestris</i> )	Fruit	(23, 200, 298, 726)
	<i>Quillaja</i> sp-----	-----	(478)
	<i>Rubus</i> sp-----	Fruit	(23, 782)
	<i>R. fruticosus</i> -----	{ Leaf	(205) (465)
	<i>R. idaeus</i> -----	Fruit	(732)
	<i>Cinchona</i> spp-----	Bark	(284, 586)
Rubiaceae	<i>Coffea</i> sp-----	Seed	(46)
	<i>C. arabica</i> -----	Fruit capsule	(270)
	<i>Dentella asiatica</i> -----	-----	(292)
	<i>Galium lucidum</i> -----	Leaf	(343)
	<i>Citrus aurantium</i> -----	{ Fruit Leaf Peel	(23, 482, 782) (660) (659)
	<i>C. decumana</i> ( <i>C. grandis</i> )	{ Fruit Peel	(326, 439) (659)
Rutaceae	<i>C. limon</i> -----	{ Fruit Peel	(23, 326, 482, 782) (659)
	<i>C. medica</i> -----	{ Petiole	(77, p. 165, ref. 4)
	<i>C. nobilis</i> ( <i>C. reticulata</i> )	Fruit	(326)
Santalaceae	<i>Santalum album</i> -----	-----	(482) (309)
Saxifragaceae	{ <i>Ribes grossularia</i> ----- <i>R. rubrum</i> -----	-----	(23, 104, 782) (198)
Simarubaceae	<i>R. sanguineum</i> -----	-----	(358)
	<i>Quassia amara</i> -----	Root bark	(772, p. 641 note 1)

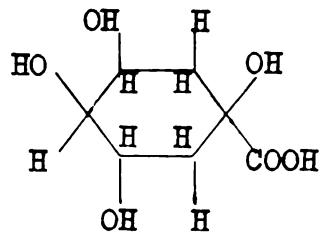
Family	Genus and species	Source	Reference
<b>Oxalic Acid—Continued</b>			
Solanaceae-----	<i>Capsicum annuum</i> ( <i>C. frutescens</i> ). <i>Datura</i> sp----- <i>D. stramonium</i> -----	----- Leaf-----	(130) (28, 63, 236) (509) (455)
	<i>Nicotiana</i> sp-----	{ Leaf----- -----	{ (30, 493, 505, 569, 574, 575, 662, 748, 749, 805) (32, 686, 707, 708, 751) (455; 687; 772, p. 1112, note 2)
	<i>N. tabacum</i> -----	Leaf-----	(509)
	<i>Solanum</i> sp-----	{ ----- Fruit-----	{ (4, 63, 122, 533, 686, 810) (7, 23, 104, 351, 381, 782)
	<i>S. lycopersicum</i> ( <i>Lycopersicon esculentum</i> ). <i>S. tuberosum</i> -----	Unripe fruit Tuber-----	{ (83, 84) (23, p. 99, fin. 2; 126; 303; 426; 455; 562; 656; 782) (8)
Sterculiaceae-----	<i>Sterculia plantanifolia</i> ( <i>Firmiana simplex</i> ). <i>Theobroma cacao</i> -----	----- -----	(23, 236, 452, 453, 782) (236, 292, 785)
Theaceae-----	-----	-----	(509)
Umbelliferae-----	<i>Angelica archangelica</i> ----- <i>Anethum graveolens</i> ----- <i>Apium graveolens</i> ----- <i>Pastinaca sativa</i> ----- <i>Petroselinum sativum</i> ( <i>P. crispum</i> ).-----	Root----- Leaf----- ----- ----- -----	(690) (782) (23) (782) (782)
Valerianaceae-----	<i>Valeriana officinalis</i> ----- <i>Valerianella</i> sp----- <i>Ampelopsis</i> sp----- <i>A. quinquefolia</i> ( <i>Parthenocissus quinquefolia</i> ).-----	----- ----- Fruit----- do-----	(91) (509) (509) (557)
Vitaceae-----	<i>Vitis vinifera</i> -----	Leaf and fruit----- Leaf and shoot----- Sap----- Vines----- Leaf-----	(23, 184, 186, 276) (278, 280) (343) (479) (480, 804) (481) (77, p. 165, ref. 4)
Zingiberaceae-----	<i>Hedychium</i> sp-----	Phloem-----	(77, p. 165, ref. 4)
Zygophyllaceae---	<i>Guaiacum</i> sp-----	Phloem-----	

Family	Genus and species	Source	Reference
<b>Phthalic Acid</b>			
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Papaveraceae	<i>Papaver somniferum</i>		(635)
<b>Pimamic Acid</b>			
	<b>d-pimamic</b>	<b>levopimamic</b>	
<hr/>			
Pinaceae	$\left\{ \begin{array}{l} Picea vulgaris (P. abies) \\ P. excelsa (P. abies) \\ Pinus (5 spp.) \\ P. maritima \\ P. palustris \\ P. pinaster \\ P. sylvestris \end{array} \right.$	Resin ----- do ----- Oleoresin ----- Resin ----- Oleoresin ----- Resin ----- Turpentine gum.	(67) (260, 345, 346) (260) (157, 378) (35, 257) (357) (503) (159) (259, 274)
<b>Piperonilic Acid</b>			
Rubiaceae	<i>Palicourea densiflora</i>	Bark	(318)

Family	Genus and species	Source	Reference
<b>Podocarpic Acid</b>			
			
Pinaceae-----	$\left\{ \begin{array}{l} Dacrydium cupressinum \\ Podocarpus cupressina \\ P. dacrydioides \end{array} \right.$	-----	(161, 649) (500, 649) (161, 649)
<b>Protocatechuic Acid</b>			
			
Bignoniaceae-----	<i>Crescentia</i> sp-----	Crude curare---	(330, 783)
Globulariaceae-----	<i>Globularia alypum</i> -----	-----	(743)
Liliaceae-----	<i>Allium cepa</i> -----	Skin-----	(20, 389, 390, 762)
Magnoliaceae-----	$\left\{ \begin{array}{l} Ilicium anisatum \\ I. religiosum \\ I. verum \end{array} \right.$	Fruit and seed-----	(498) (121, 164, 165)
Saxifragaceae-----	<i>Hydrangea thunbergii</i> ( <i>H.</i> <i>serrata</i> ).-----	Fruit----- Capsule----- Leaf-----	(76) (698)
Vitaceae-----	<i>Vitis vinifera</i> -----	do-----	(73)

Family	Genus and species	Source	Reference
<b>Pyruvic Acid</b>			
	$\begin{array}{c} \text{CH}_3 \\   \\ \text{C}=\text{O} \\   \\ \text{COOH} \end{array}$		
Chenopodiaceae	<i>Spinacia oleracea</i>	Leaf	(31)
Euphorbiaceae	<i>Ricinus communis</i>	Germinating seed.	(145)
Gramineae	<i>Hordeum vulgare</i>	{ Seedling	(57) (314)
Labiatae	<i>Mentha piperita</i>	Leaf	(709, 711)
	<i>Arachis hypogaea</i>	Seedling	(195, 196)
Leguminosae	{ <i>Pisum sativum</i>	{ Leaf Seedling	(31) (759) (757)
	<i>Trifolium pratense</i>		(757)
Liliaceae	{ <i>Allium cepa</i>	{	(55) (451)
	<i>Tulipa gesneriana</i>	Juice	
Rosaceae	<i>Pyrus malus (Malus sylvestris)</i>	Fruit	(709, 710) (298)
Solanaceae	<i>Solanum tuberosum</i>	Tuber	(38, 711)
Umbelliferae	<i>Daucus carota</i>	{ Leaf and root Root	(709) (711)

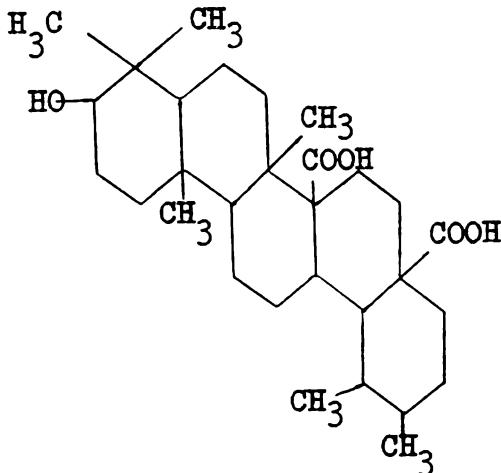
### Quinic Acid



Compositae	<i>Taraxacum officinale</i>	Leaf	(404)
	<i>Vaccinium arctostaphylos</i>		(670)
Ericaceae	{ <i>V. myrtillus</i>	{ Young leaf	(325) (341)
	<i>V. oxycoccus</i>	Foliage	(821)
	<i>V. vitis-idaea</i>		(352, 379) (328)
Gramineae	Mixed herbage	Leaf	(403, 404)
Leguminosae	<i>Tamarindus indica</i>	Fruit	(299)
Magnoliaceae	<i>Illicium verum</i>	Capsule	(325)
	<i>Cedrus libani</i>	Needle	(76)
Pinaceae	{ <i>Larix europaea (L.) decidua</i> .	do	(701)
	<i>Picea excelsa (P. abies)</i>	Young shoot	(701)
Ranunculaceae	<i>Aconitum septentrionale</i>		(340) (341) (315)

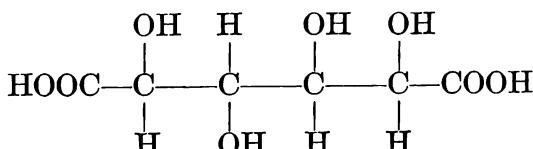
Family	Genus and species	Source	Reference
<b>Quinic Acid—Continued</b>			
Rosaceae-----	<i>Prunus domestica</i> -----	{ Ripe fruit-----	(147)
	<i>P. persica</i> -----	{ Fruit-----	(352)
	<i>Pyrus communis</i> -----	{ Juice-----	(18, 133) (592)
	<i>P. malus (Malus sylvestris).</i>	{ Fruit-----	(733) (295, 298)
	<i>Cinchona</i> sp-----	{ Juice-----	(530, 531, 700) (284, 287, 521, 522, 586, 741)
Rubiaceae-----	<i>C. cordifolia</i> -----	-----	(522)
Solanaceae-----	<i>Coffea</i> sp-----	Fruit-----	(823)
	<i>Gallium mollugo</i> -----	-----	(490)
	<i>Nicotiana tabacum</i> -----	Leaf-----	(772, p. 1112, note 2)
Umbelliferae-----	<i>Angelica archangelica</i> -----	Root-----	(690)
Vitaceae-----	<i>Vitis vinifera</i> -----	Fruit-----	(352)

### Quinovic Acid



Rosaceae-----	<i>Potentilla</i> -----	Root-----	(589)
Rubiaceae-----	<i>Cinchona</i> spp-----	-----	(284, 586, 614)
Zygophyllaceae--	<i>Zygophyllum coccineum</i> -----	-----	(669)

### Saccharic Acid

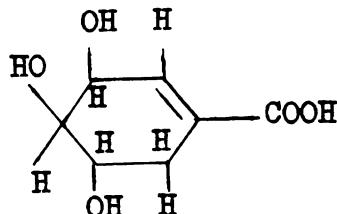


Moraceae-----	<i>Ficus elastica</i> -----	Latex-----	(232)
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Family	Genus and species	Source	Reference
<b>Saccharinic Acid</b>			
$\text{CH}_2\text{OH}-\text{CHOH}-\text{CHOH}-\text{C}(\text{CH}_3)(\text{OH})-\text{COOH}$			
Bromeliaceae-----	<i>Ananas sativas</i> ( <i>A. comosus</i> ).	Fruit-----	(79)
<b>Salicylic Acid</b>			
Compositae-----	{ <i>Calendula officinalis</i> -----		(143)
	<i>Matricaria chamomilla</i> -----	Flower head-----	(548)
Euphorbiaceae-----	<i>Cluytia similis</i> -----	Stem and leaf-----	(729)
Iridaceae-----	<i>Iris versicolor</i> -----	Rhizome-----	(554)
Leguminosae-----	<i>Daviesia latifolia</i> -----	Leaf and stem-----	(555)
	<i>Glycyrrhiza glabra</i> -----	Root-----	(142)
	<i>Trifolium pratense</i> -----	Flower-----	(535)
	<i>Aloe</i> sp-----		(731)
Liliaceae-----	<i>Gloriosa superba</i> -----	Tuber-----	(123)
	<i>Hyacinthus</i> sp-----		(241)
	<i>Tulipa</i> sp-----		(241)
	<i>Yucca</i> sp-----		(241)
Moraceae-----	<i>Morus</i> sp-----	Fruit-----	(142)
Pittosporaceae-----	<i>Pittosporum undulatum</i> -----	do-----	(556)
Polygalaceae-----	<i>Polygala</i> sp-----	Root-----	(639)
Ranunculaceae-----	<i>Cimicifuga racemosa</i> -----	Rhizome-----	(188)
Resedaceae-----	<i>Reseda odorata</i> -----		(421)
		{ Calyx and pedicel.	(435)
		<i>Fragaria</i> sp-----	(543, 544, 712, 735)
		Fruit pulp and juice.	(689)
		<i>Prunus armenica</i> -----	
		<i>P. avium</i> -----	(791)
Rosaceae-----	<i>P. cerasus</i> -----	do-----	(712)
		<i>P. domestica</i> -----	(142, 143, 243, 712)
		<i>P. persica</i> -----	(311)
		<i>Rubus fruticosus</i> -----	(712)
		<i>R. idaeus</i> -----	(712)
		<i>R. occidentalis</i> -----	(243, 712, 735)
		<i>Spiraea ulmaria</i> ( <i>Filipendula ulmaria</i> ). -----	(266, 791)
Rubiaceae-----	<i>Uragoga ipecacuanha</i> ( <i>Cephaelis ipeca-cuanha</i> ). -----	Flower-----	(712)
		Root-----	(421, 422)
Rutaceae-----	{ <i>Barosma</i> sp-----		(770)
Saxifragaceae-----	<i>Casimiroa edulis</i> -----	Seed-----	(549)
	<i>Ribes</i> sp-----	Fruit-----	(712)

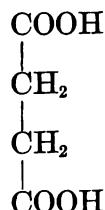
Family	Genus and species	Source	Reference
<b>Salicylic Acid—Continued</b>			
Solaneaceae-----	<i>Solanum lycopersicum</i> ( <i>Lycopersicon esculentum</i> )	-----	(194, 519)
Violaceae-----	<i>Viola</i> (6 spp.)----- <i>V. syrtica</i> ----- <i>V. tricolor</i> -----	Leaf, stem, and rhizome. Flower, leaf, stem, and root. Leaf, stem, and rhizome.	(143) (423) (242)
Vitaceae-----	<i>Vitis labrusca</i> ----- <i>V. vinifera</i> -----	Fruit----- do-----	(243) (435)

### Shikimic Acid



Ginkgoaceae-----	<i>Ginkgo biloba</i> -----	Leaf-----	(261, 808)
Gramineae-----	<i>Lolium perenne</i> -----	-----	(596)
	<i>Illicium anisatum</i> -----	-----	(498)
Magnoliaceae-----	<i>I. religiosum</i> ----- <i>I. verum</i> -----	Fruit----- Carpel----- Carpel-----	(121, 164) (165) (655)
Pinaceae-----	25 spp-----	-----	(76, 213)
Taxaceae-----	4 spp-----	-----	(261) (261)

### Succinic Acid



Franzen and Ostertag (208) have made a critical review of the literature on the occurrence of succinic acid.]

Aceraceae-----	<i>Acer saccharum</i> -----	Sirup----- Sugar sand-----	(468, 542) (469)
Amaryllidaceae-----	<i>Narcissus poeticus</i> -----	Leaf and root-----	(752)
Begoniaceae-----	<i>Begonia semperflorens</i> -----	-----	(611, 732)
Betulaceae-----	<i>Corylus</i> sp-----	Nut-----	(144) (72)
Bigoniaceae-----	<i>Crescentia</i> sp-----	Crude curare-----	(330)

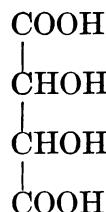
## Succinic Acid—Continued

Bombacaceae	<i>Adansonia digitata</i>	Fruit	(5)
Celastraceae	<i>Gouopia tomentosa</i>	Wood	(156)
Chenopodiaceae	<i>Beta vulgaris</i>	Juice	(673)
	<i>Spinacia oleracea</i>	Top and root	(571)
	<i>Artemisia absinthium</i>	Leaf and root	(742)
	<i>Helianthus annuus</i>	Leaf	(377)
Compositae	<i>Lactuca</i> spp	Leaf	(706)
	<i>L. sativa</i>	Leaf	(819)
	<i>L. virosa</i>	Leaf	(58)
	<i>Taraxacum officinale</i>	Leaf	(515)
	<i>Bryophyllum</i> sp	Leaf	(347, 732)
	<i>B. calycinum</i>	do	(347)
Crassulaceae	<i>Echeveria secunda</i>	Detached leaf	(404)
	<i>Sedum acre</i>	Leaf	(570, 571)
	<i>Sempervivum glaucum</i>	do	(687)
Cruciferae	<i>Brassica oleracea</i>	Leaf and bud	(52)
	<i>Bunias orientalis</i>	Stem, leaf, and flowering top	(475)
Ericaceae	<i>Vaccinium myrtillus</i>	Fruit	(316)
		Whole plant	(325)
Euphorbiaceae	<i>Ricinus communis</i>		(583)
Fagaceae	<i>Fagus sylvatica</i>	Sap	(65, 145)
	<i>Quercus</i> sp	Nut	(646)
	<i>Avena sativa</i>		(144)
	<i>Bambusa</i> sp		(299)
	<i>Dactylis glomerata</i>		(291)
	<i>Hordeum vulgare</i>	Leaf	(70)
		Etiolated shoot	(134)
		Seedling	(114, 687)
Gramineae	<i>Lolium perenne</i>		(168)
	<i>Oryza</i> spp		(291)
	<i>O. sativa</i>		(291, 686)
	<i>Phleum pratense</i>		(314, 739)
	<i>Saccharum officinarum</i>	Juice	(134)
			(809)
			(256)
			(134)
			(68, ref. 57;
Juglandaceae	<i>Triticum</i> sp		603; 604; 605;
	<i>Zea mays</i>		704, ref. 162;
Lauraceae	<i>Juglans regia</i>		794; 811)
	<i>Persea gratissima</i>		(739)
	<i>(P. americana)</i>		(43, 571)
Leguminosae	<i>Lupinus albus</i>	Seedling	(144)
	<i>Phaseolus coccineus</i>		(514)
	<i>Pisum sativum</i>	Seedling	(291)
Loganiaceae	<i>Tamarindus indica</i>		(58)
Malvaceae	<i>Strychnos toxifera</i>		(291)
	<i>Gossypium</i> sp		(202, 325)
Moraceae	<i>Morus</i> sp		(70, 71)
	<i>M. alba</i>		(181)
	<i>M. indica</i>		(806)
Musaceae	<i>Musa basjoo</i>	Bark exudate	(225)
	<i>M. sapientum</i>	Leaf	(326)
		Juice	(623)
		Fruit	(193)

Family	Genus and species	Source	Reference
<b>Succinic Acid—Continued</b>			
Papaveraceae-----	<i>Chelidonium majus</i> -----	-----	(636)
	<i>Eschscholtzia</i> sp-----	-----	(766)
	<i>Glaucium luteum</i> -----	Juice-----	(634)
	<i>Papaver somniferum</i> -----	Turpentine-----	(766)
	{ <i>Abies pectinata</i> -----	{ do-----	(380)
	( <i>A. alba</i> ).-----	Resin-----	(113)
	<i>Agathis australis</i> -----	Resin-----	(722)
Pinaceae-----	<i>A. dammara</i> -----	do-----	(457)
	<i>Larix decidua</i> -----	do-----	(719)
	<i>Picea vulgaris</i> ( <i>P. abies</i> )-----	do-----	(723)
	<i>Pinus</i> sp-----	Sap-----	(720)
	<i>P. sylvestris</i> -----	Resin-----	(646)
	<i>Fagopyrum esculentum</i> -----	{ Leaf and stem-----	(721)
		{ Rhizome and stem-----	(144)
	<i>Rheum hybridum</i> -----	Leaf-----	(571)
Polygonaceae-----	<i>R. officinale</i> -----	Petiole-----	(612)
	<i>R. rhabonticum</i> -----	Leaf and petiole-----	(687)
	<i>R. undulatum</i> -----	Petiole-----	(102)
Proteaceae-----	<i>Orites excelsa</i> -----	Wood-----	(571)
Ranunculaceae-----	<i>Anemone nemorosa</i> -----	Leaf-----	(343)
		Fruit-----	(664)
	<i>Fragaria</i> sp-----	do-----	(400)
	<i>Prunus avium</i> -----	{ Juice-----	(732)
	<i>P. cerasus</i> -----	Fruit-----	(319)
	<i>P. communis</i> -----	Fruit pulp-----	(337)
	<i>P. persica</i> -----	Fruit-----	(320)
Rosaceae-----	<i>Pyrus aucuparia</i> ( <i>Sorbus aucuparia</i> ).-----	{ do-----	(18)
	<i>P. communis</i> -----	Juice-----	(206)
	<i>P. malus</i> ( <i>Malus sylvestris</i> ).-----	Fruit-----	(401)
		do-----	(592)
	<i>Rubus fruticosus</i> -----	Leaf-----	(733)
		Fruit-----	(48, 105, 106)
Rutaceae-----	<i>R. idaeus</i> -----	Leaf-----	(200)
Santalaceae-----	<i>Citrus limon</i> -----	Fruit-----	(530, 702)
Sapotaceae-----	<i>Santalum album</i> -----	-----	(205)
Saxifragaceae-----	<i>Mimusops</i> sp-----	-----	(465)
Scrophulariaceae-----	<i>Ribes rubrum</i> -----	-----	(211, 319, 732)
	<i>Digitalis purpurea</i> -----	Leaf-----	(326)
	<i>Atropa belladonna</i> -----	Fruit-----	(309)
		Leaf-----	(515)
Solanaceae-----	<i>Nicotiana</i> sp-----	Leaf-----	(198)
	<i>N. tabacum</i> -----	Leaf-----	(87, 331)
		Fruit-----	(366)
	<i>Solanum lycopersicum</i> ( <i>Lycopersicon esculentum</i> ).-----	{ Overripe fruit-----	(43, 571, 653, 686)
		Leaf and stalk-----	(7, 736, 737)
	<i>S. tuberosum</i> -----	Leaf-----	(82, 83, 84)
Umbelliferae-----	<i>Angelica archangelica</i> -----	Tuber-----	(571)
	<i>Daucus carota</i> -----	Root-----	(686, 687)
Vitaceae-----	<i>Vitis vinifera</i> -----	do-----	(814)
		Leaf-----	(690)
		Unripe fruit-----	(105, 106, 409)
		Fruit-----	(73)
		Sap and fruit-----	(101)
		Sap-----	(280)
			(481, 804)

Family	Genus and species	Source	Reference
<b>Syringic Acid</b>			
Gramineae-----	<i>Saccharum officinarum</i>	{Juice----- Crude molasses-----	(605) (696)

## Tartaric Acid



[Franzen and Helwert (201) have made a critical review of literature on the occurrence of tartaric acid]

Aceraceae	<i>Acer saccharum</i>	Sugar sand	(398, 666)
Amaryllidaceae	<i>Agave americana</i>	Sirup	(469)
	{ <i>Mangifera indica</i>	Leaf sap	(107)
Anacardiaceae	{ <i>Rhus coriaria</i>	-----	(86)
	{ <i>R. semialata</i>	-----	(152)
	{ <i>Spondias purpurea</i>	-----	(734)
Araliaceae	<i>Aralia hispida</i>	Fruit	(558)
Asclepiadaceae	<i>Asclepias syriaca</i>	Milky sap	(222)
Berberidaceae	{ <i>Berberis integerrima</i>	Fruit	(643)
	{ <i>Caulophyllum thalictroides</i>	Fruit pulp	(343)
Betulaceae	<i>Betula alba</i>	Sap	(679)
Bombacaceae	{ <i>Adansonia</i> sp	Fruit	(217)
	{ <i>A. digitata</i>	Fruit pulp	(445)
Bromeliaceae	<i>Ananas sativas</i> ( <i>A. comosus</i> )	Fruit	(523, p. 779)
		do	(5)
		do	(79, 515)
	<i>Diervilla florida</i>	Fruit	(135)
	<i>Lonicera xylosteum</i>	do	(170)
	<i>Sambucus callicarpa</i>	do	(124)
	{ <i>S. ebulus</i>	do	(174)
Caprifoliaceae	{ <i>S. nigra</i>	Root	(175)
	{ <i>Symphoricarpos racemosus</i> ( <i>S. albus</i> ).	Fruit	(173)
	<i>Viburnum lantana</i>	do	(663)
	<i>V. nudum</i>	-----	(178)
Caricaceae	<i>Carica papaya</i>	Fruit	(406)
	{ <i>Celastrus obscurus</i>	Leaf	(513)
Celastraceae	{ <i>C. scandens</i>	Fruit	(154)
	{ <i>Euonymus atropurpureus</i>	Root bark	(776)
	{ <i>E. europaeus</i>	Seed kernel	(463)
		-----	(245)

Family	Genus and species	Source	Reference
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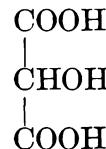
### Tartaric Acid—Continued

Chenopodiaceae	<i>Beta vulgaris</i>	{ Root Root and leaf	(226, 396) (742)
Commelinaceae	<i>Chenopodium ambrosioides</i>	-----	(201, p. 297)
	<i>Tradescantia purpurea</i>	Stem sap	(219)
	<i>T. zebrina</i> ( <i>Zebrina pendula</i> )	----- do -----	(219)
Compositae	<i>Bellis perennis</i>	-----	(179)
	<i>Helianthus tuberosus</i>	Tuber	(92, 226)
	<i>Matricaria chamomilla</i>	Flower	(269)
Cornaceae	<i>Cornus paniculatum</i> ( <i>C. racemosus</i> ).	Fruit	(648)
	<i>C. sericea</i>	----- do -----	(679)
Cruciferae	<i>Capella bursapastoris</i>	-----	(131)
Elaeagnaceae	<i>Hippophae rhamnoides</i>	Fruit	(797)
Elaeocarpaceae	<i>Elaeocarpus serratus</i>	----- do -----	(807)
	<i>Vaccinium</i> sp	Leaf	(328)
Ericaceae	<i>V. corymbosum</i>	Fruit	(257)
	<i>V. vitisidaea</i>	{ Leaf Fruit	(491) (792)
Eucommiaceae	<i>Eucommia ulmoides</i>	Leaf	(246)
Euphorbiaceae	<i>Euphorbia cyparissias</i>	Milky sap	(774)
	<i>E. platyphylla</i>	----- do -----	(775)
	<i>Phyllanthus emblica</i>	-----	(326)
	<i>Ricinus communis</i>	-----	(65)
Fagaceae	<i>Quercus pedunculata</i> ( <i>Q. robur</i> ).	Wood	(442)
Geraniaceae	<i>Geranium zonale</i>	-----	(93)
Gramineae	<i>Bambusa</i> sp	Shoot	(621)
	<i>Saccharum officinarum</i>	Juice	(811)
Guttiferae	<i>Sorghum vulgare</i>	-----	(416, 786, 787)
Hydnoraceae	<i>Garcinia gambogia</i>	Fruit rind	(367)
Labiatae	<i>Prosopanche burmeisteri</i>	-----	(816)
	<i>Glechoma hederacea</i>	-----	(176)
Lauraceae	<i>Orthosiphon stamineus</i>	-----	(338)
	<i>Persea gratissima</i> ( <i>P. americana</i> ).	Fruit pulp	(514, 515)
	<i>Astragalus</i> sp	Twig	(408)
Leguminosae	<i>Bauhinia reticulata</i>	Fruit and leaf	(578)
	<i>Cassia</i> sp	Leaf	(716, 763)
	<i>C. acutifolia</i>	----- do -----	(376)
		Fruit pulp	(81, 590, 688, 746)
	<i>Tamarindus indica</i>	-----	(3; 192; 201; ref. 28; 202; 233; 740)
		Leaf	(237)
		Mesocarp	(271)
		Green and ripe fruit.	(310, 558)
		Fruit	(326, 693)
Liliaceae	<i>Clintonia borealis</i>	Fruit	(661)
	<i>Erythronium denscanis</i>	Bulb	(153)
	<i>Smilacina bifolia</i> (?)	Fruit	(163)
	<i>S. racemosa</i>	----- do -----	(163)
Magnoliaceae	<i>Schizandra chinensis</i>	----- do -----	(525)
Moraceae	<i>Morus indica</i>	Leaf	(326)
Myrtaceae	<i>Eugenia australis</i>	-----	(407)
	<i>Psidium guajava</i>	-----	(620)
Musaceae	<i>Musa sapientum</i>	Fruit	(193)
Orchidaceae	<i>Vanilla planifolia</i>	----- do -----	(384)
Oxalidaceae	<i>Oxalis corniculata</i>	Leaf	(237)

Family	Genus and species	Source	Reference
<b>Tartaric Acid—Continued</b>			
Papaveraceae	<i>Adlumia cirrhosa</i> ( <i>A. fungosa</i> ). <i>Chelidonium majus</i> . <i>Fumaria officinalis</i> . <i>Papaver somniferum</i> .	Root----- Leaf----- Sap----- Capsule-----	(633) (560) (201, p 295) (141)
Pinaceae	<i>Pinus sylvestris</i> .	Pollen-----	(363)
Piperaceae	<i>Piper nigrum</i> .		(520)
Polygonaceae	<i>Polygonum reynoutria</i> .	Stem-----	(697)
Ranunculaceae	<i>Aconitum napellus</i> . <i>Craataegus</i> sp. <i>Cydonia vulgaris</i> . <i>Eriobotrya japonica</i> . <i>Fragaria</i> sp.	----- Fruit----- -----do----- do----- Fruit-----	(588) (433) (119, 693, 714) (368) (119, 458, 714) (119, 487, 489, 693) (714) (119)
Rosaceae	<i>Prunus armeniaca</i> . <i>P. avium</i> . <i>P. cerasus</i> . <i>P. domestica</i> . <i>P. persica</i> . <i>P. spinosa</i> . <i>Pyrus arbutifolia</i> . <i>P. aucuparia</i> ( <i>Sorbus aucuparia</i> ). <i>P. malus</i> ( <i>Malus sylvestris</i> ). <i>Rubus</i> sp. <i>R. idaeus</i> .	{ Fruit----- ----- Fruit----- do----- do----- Fruit----- Fruit----- Fruit----- Juice----- Fruit----- Juice----- Sap-----	(487, 488, 489, 714) (488, 629) (642) (584) (386a, 401) (487, 488, 489, 714) (487, 489) (693) (132) (458) (119, 385) (382) (516) (439)
Rubiaceae	<i>Coffea</i> sp.		
Rutaceae	<i>Citrus decumana</i> ( <i>C. reticulata</i> ).	Fruit-----	
Santalaceae	<i>Cusparia trifoliata</i> .		(201, ref. 1)
Sapindaceae	<i>Lepidomeria acida</i> . <i>Sapindus saponaria</i> .	Fruit----- -----	(591) (283)
Sapotaceae	<i>Achras sapota</i> . <i>Bassia latifolia</i> . <i>Sideroxylon crassipedicellatum</i> . <i>Ribes</i> sp.	----- Fruit----- Fruit----- -----	(517) (344) (517) (458)
Saxifragaceae	<i>R. grossularia</i> . <i>R. nigrum</i> . <i>R. rubrum</i> . <i>Antirrhinum majus</i> . <i>Digitalis grandiflora</i> . <i>Euphrasia officinalis</i> . <i>Linaria cymbalaria</i> . <i>Scrophularia nodosa</i> . <i>Veronica officinalis</i> . <i>Cyphomandra calycina</i> . <i>Physalis peruviana</i> .	----- ----- ----- ----- ----- ----- ----- ----- ----- Fruit-----	(792) (119) (209, 792) (765) (765) (172) (765) (765) (171) (518) (373)
Scrophulariaceae	<i>Solanum dulcamara</i> . <i>S. lycopersicum</i> ( <i>Lycopersicon esculentum</i> ). <i>S. tuberosum</i> .	----- do----- Fruit-----	(15, 776) (4) (7, 177, 343, 693)
Solanaceae	<i>Theobroma cacao</i> . <i>Tilia vulgaris</i> . <i>Parietaria officinalis</i> .	Tuber----- Berry----- -----	(167) (89) (201, ref. 29) (283)
Sterculiaceae			
Tiliaceae			
Urticaceae			

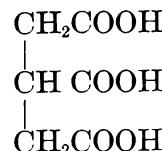
Family	Genus and species	Source	Reference
<b>Tartaric Acid—Continued</b>			
Vitaceae-----	<i>Ampelopsis hederacea</i> -----	Leaf-----	(186) (234) (235)
	<i>(Parthenocissus quinquefolia).</i>	Leaf-----	(532)
	<i>Parthenocissus quinquefolia.</i>	Leaf-----	
	<i>Vitis</i> sp-----	Leaf-----	(11) (505) (798)
	<i>V. hederaceae (Parthenocissis quinquefolia).</i>	Leaf-----	
	<i>V. labrusca</i> -----	Juice-----	(413, 629) (466)
	<i>V. sylvestris</i> -----	Fruit-----	(598)
		Fruit-----	
		-----	(13, 64, 216, 280, 302, 480)
		Fruit-----	(14, 190, 297, 326, 487, 541, 693)
		Leaf-----	(73, 343, 527, 645)
	<i>V. vinifera</i> -----	Juice-----	(139, 214, 223, 255, 355, 528, 647)
		Sap-----	(374, 799, 804)
		Vine-----	(215, 278)
		Unripe fruit---	(417, 496, 526)
		Young shoot and leaf.	(479)

### Tartronic Acid



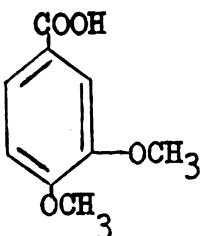
Gramineae-----	-----	-----	(597)
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### Tricarballylic Acid



Aceraceae-----	<i>Acer saccharum</i> -----	Sugar sand-----	(398, 469)
		Evaporated juice.	(391, 402)
Chenopodiaceae	<i>Beta vulgaris</i> -----	Root-----	(392, 705)
		Juice-----	(395)
Gramineae-----	<i>Hordeum vulgare</i> -----	Root and leaf-----	(742)
		Whole plant-----	(474)

Family	Genus and species	Source	Reference
<b>Ursolic Acid</b>			
	<p>The diagram shows the chemical structure of Ursolic Acid, a triterpenoid. It consists of three fused cyclohexane rings. A hydroxyl group (HO) is at C1. A methyl group (CH<sub>3</sub>) is at C2. A carboxylic acid group (COOH) is at C3. Another methyl group (CH<sub>3</sub>) is at C4. A double bond is between C5 and C6. A methyl group (CH<sub>3</sub>) is at C7. A double bond is between C8 and C9. A methyl group (CH<sub>3</sub>) is at C10.</p>		
Apocynaceae-----	<i>Allamanda cathartica</i> -----	Leaf-----	(26)
Aquifoliaceae-----	$\begin{cases} Ilex aquifolium \\ I. latifolia \\ I. paraguariensis \end{cases}$	$\begin{cases} \text{Cuticle} \\ \text{Leaf} \end{cases}$	$\begin{cases} (189) \\ (329) \\ (440) \end{cases}$
Cornaceae-----	<i>Cornus florida</i> -----	Flower and bract-----	(619)
	$\begin{cases} Arctostaphylos uva-ursi \\ Enkianthus quinqueflorus \\ Erica arborea \\ E. carnea \\ E. mediterranea \\ Kalmia angustifolia \\ Leucothoe keiskei \\ Rhododendron (6 spp.) \\ R. pulchrum \\ R. simsii \\ Vaccinium macrocarpon \\ V. myrtillus \\ V. oxycoccus \\ V. vitis-idaea \end{cases}$	$\begin{cases} \text{Leaf} \\ \text{do} \\ \text{Pomace} \\ \text{Fruit pulp} \\ \text{Fruit pulp} \\ \text{Fruit pulp} \end{cases}$	$\begin{cases} (617) \\ (25) \\ (189) \\ (189) \\ (189) \\ (313) \\ (657) \\ (25) \\ (26) \\ (430) \\ (189, 583) \\ (371) \\ (189) \end{cases}$
Ericaceae-----			
Labiatae-----	$\begin{cases} Salvia officinalis \\ Thymus vulgaris \end{cases}$	-----	$\begin{cases} (97) \\ (609) \end{cases}$
Myrtaceae-----	<i>Psidium guajava</i> -----	Leaf-----	(27)
Punicaceae-----	<i>Punica granatum</i> -----	Peel and leaf-----	(98)
Pyrolaceae-----	$\begin{cases} Pyrola minor \\ P. umbellata \end{cases}$	-----	$\begin{cases} (189) \\ (189) \end{cases}$
	$\begin{cases} Crataegus oxyacantha \\ Eriobotrya japonica \\ Prunus avium \\ P. serotina \end{cases}$	$\begin{cases} \text{Cuticle} \\ \text{Leaf} \\ \text{Fruit skin} \\ \text{Fruit} \end{math} $	$\begin{cases} (431) \\ (251) \\ (617) \\ (428) \end{math} $
Rosaceae-----			
Solanaceae-----	$\begin{cases} Pyrus communis \\ P. malus (Malus sylvestris) \\ Anthocercis intricata \\ A. littorea \\ A. odgersii \\ Verbena stricta \end{cases}$	$\begin{cases} \text{Leaf} \\ \text{Fruit skin} \\ \text{Fruit skin} \\ \text{Fruit cuticle} \\ \text{Fruit skin} \\ \text{Fruit cuticle} \end{math} $	$\begin{cases} (275, 617) \\ (429) \\ (21) \\ (21) \\ (21) \\ (506) \end{cases}$
Verbenaceae-----			

Family	Genus and species	Source	Reference
<b>Veratric Acid</b>			
	 <chem>O=Cc1ccc(Oc2ccccc2)c(O)c1</chem>		

Liliaceae----- *Sabadilla officinalis* ----- Seed----- (441)

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